

Colorimetry by Assessment TwAc Booster System Efficiency

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ABSTRACT

Background: Ever-increasing demand for cosmetic correction of evolutionary changes of facial skin dictates the search of methods having pathogenetic mechanism influencing aging processes and provide a long-term therapeutic effect. **Methods:** The author offered a complex correction of facial skin aging symptoms using optimum doses of botulinum toxin A and least traumatic booster system on the basis of TwAc polynucleotides. A high clinical performance of the method is provided through the synergy of the biological effect of the selected preparations and pathogenetics of their influence on skin structural elements. High efficiency and low injury rate of the describe method allows applying it in mass dermatocosmetological practices. **Results:** Achieved results are accessed by means of colorimetry which vividly and accessibly for the patients reflects dynamics of positive changes in skin problem areas. Colorimetric characteristics of the involutinal changed facial skin: shade shift of the facial basic color to the violet zone of the spectrum (HUE 10°–40°), slight color intensity (Chroma 4.2-5.1), reflection low level is stipulated by the decreased tension, increased folding, depleted skin vascular component, increased content of melanin agent and oxyhemoglobin decreased level. **Conclusions:** Application of complex correction method for involutinal changed facial skin in long dates after procedure.

KEYWORDS: Colorimetry, cosmetology, TwAc booster, correction of the involutinal changed facial skin.

I. INTRODUCTION:

Relevance of the topic:

One of the most topical issues of modern medicine is preservation and improvement of skin appearance, its morphological and functional peculiarities assisting in formation of healthy, harmonically intelligent person and improves its general physical and moral state. So far as with aging the amount of elastin, collagen and basic substance decreases as a result its functional capabilities loosen. The search of new methods for effective cosmetic correction of involutinal changed human skin tissues acquires specific topicality and separates to promising approach in modern dermatocosmetology.

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Psychological and social adaptation of the person in the society is largely determined by the kinetics of facial muscular system. Expression of the person's emotional state is provided by the activity, generally, of 12 facial muscles and only four of them participate in the reflection of the brightest human emotions: rage, fear, sadness, disgust, surprise and joy. Normal physiological functions, biological systems condition (fermentative, adaptative, metabolic) depend on the degree of age-related changes in outer skin coverings. Multiply repeating single-type mimic muscle contractions cause constant stretch of the appropriate skin areas and gradually lead to formation of hyper-functional skin wrinkles. Currently four of their main types belonging to the upper face have been described: m.frontalis contraction, m.corrugator supercilii and lateral m.procerus portion assisting in formation of horizontal wrinkle on the forehead, as well as vertical wrinkles in the glabellar area and frontonasal area. Contraction of m.orbicularis oculi provides wrinkle growth near outside corners of palpebral fissures.

Modern cosmetology practices:

Adequate correction of hyper-kinetic facial wrinkles is a complex clinical task. Modern cosmetology practices use both conservative and operative methods including different types of facial massage, electro-procedures, chemical peelings, injections of intact implants, surgical intervention and mechanical dermabrasion. Nevertheless, these approaches give no opportunity to achieve optimum effect as there is no direct effect on the mimic muscles' activity. One of the principal methods providing functional tranquility of the mimic muscles by means of chemodenervation of the synaptic cleft is the use of a botulinum toxin type A.^{1-6,8,9}

Expressive esthetic effect of the involuntional changed skin is provided by systems on the basis of GA⁹ and polynucleotides of new generation. Distinctive excellence of the polynucleotide implants is in assuring increase in skin color, as well as wrinkle amount decrease. The predominant influencing factor on skin is that the preparations based on polynucleotides have a significant anti-inflammatory effect^{20-23,31,32,35}. To obtain optimum clinical results the pathogenetically justified correction methods of involuntional changed skin and hyper-kinetic wrinkles should be combined.

Research objective:

Increase of hyper-kinetic wrinkle and involuntional changed skin cosmetic correction effectiveness on the basis of joint application TwAc booster system and botulinum toxin type A.

Research tasks:

- Investigate in complex 22 patients with involuntional changed facial skin and mimic static wrinkles.
- Study colorimetric characteristics of involution changed facial skin and assess botulinum toxin degree of influence, TwAc booster system by their joint application on the color parameters of each facial skin covering area.

Subject of research:

Involucional changes of the facial skin.

Scope of research: Facial skin colorimetric characteristics.

Practical value: Represented the synergy of the biological effect of the botulinum toxin type A and polynucleotide-based booster systems. Combined methodology of using botulinum toxin and polynucleotide-based booster systems in the correction of hyper-kinetic wrinkles provides a high clinical performance and is considered to be highly-effective, low-traumatic and may be applied in mass dermatocosmetological practices. Considering anatomic facial areas, a scheme for optimum botulinum toxin doses has been offered⁹ and method of introducing the least traumatic polynucleotide-based booster systems has been worked out.

II. Materials and METHODS:

Clinical characteristics of the investigated patients:

Clinical material is based on the supervisions of 22 patients with involucional changes of facial skin and mimic static wrinkles taken place 2016-2017 in Doctor Yudin Clinic. For the purpose of clinical selection of patients group participated in the researches, as well as for the determination of optimum therapeutic tactics for cosmetic correction of hyper-kinetic wrinkles, the classification of facial skin age-related changes developed by O.S. Panova (Tab. 1) based on the following criteria: soft tissues ptosis and skin surpluses; degree of mimic and static wrinkles manifestation, availability of skin surpluses and its texture changes gradation.

Table 1: Clinical classification of facial skin age-related changes

Skin age-related changes parameters	lass I			lass II			lass III		
Mimic wrinkles:Surface									
Medium degree									
Deep									
Static wrinkles: Surface									
Medium degree									

Deep									
Skin surpluses:Insignificant									
Moderate									
Significant									
Skin structure change:Initial									
Expressed									
Rough									

10 patients have gone through a complex treatment with botulinum toxin further TwAc booster correction. The control group consisted of 12 persons without any procedures carried out. Examined women (90%) and men (10%) were allocated according to their age groups 30–40, 40–50, 50–60 years old as follows: 30%, 40% and 30% accordingly. The nature of involution skin changes is determined basing on the anamnesis, clinical findings, skin functional condition indexes and diagnostic data. Patients’ allocation in groups according to the classes of involuntional facial skin changes is represented in Tab. 2.

Table 2: Allocation of the investigated involuntional skin changes by classes in groups.

Grouping	Classes of involuntional facial skin changes		
	2 A	2 B	3 A
Group 1 (10 persons)	1 (10 %)	7 (70 %)	2 (20 %)
Group 2 (12 persons)	2 (16.7 %)	8 (39.8 %)	2 (66.6 %)

Consequently, the examined groups do not practically differ from each other by sexual and age characters and facial skin functional condition. During visit of the doctor the patient was informed about method’s advantage and possible complications, received informed consent to examination and carrying out a treatment agreed with him/her.

At the beauty doctor consultations, the medical history and medical documentation available by the patient as to prevent somatic complications have been studied. All patients were examined by collecting

anamnesis and carrying out colometry with the help of Colorimetr Play Market for the assessment of skin covering functional condition.

Colorimetric method:

Colorimetric method lies in the following: measurement of LAB color coordinates allocation of the skin area being under cosmetological impact before procedure, immediately after it and in a month by diffusion illumination with the standard light source. Except for objective methods the assessment of the external skin covering view has been carried out through inquiry of the focus group of 30 persons according to the following assessment criterion: “healthy fresh skin look”.

Wrinkle correction method with the preparation botulinum toxin type A:

For the purpose of carrying out cosmetic correction of the skin hyper-functional wrinkles the complex preparation botulinum toxin type A in medicinal form Disport produced by Beaufour Ipsen International, France, was used. This medication is lyophilized powder for injections containing 500 OT of haemagglutinin complex type A, 125 µkg of human albumin plasma and 2.5 mg of lactose. Indications for this preparation were such cosmetic disadvantages: availability of hyper-kinetic mimic and static wrinkles on the forehead area, glabellar and periorbital areas. Contra indications to “Disport” were considered nervomuscular disruptions, pregnancy, local inflammation process, hypersensitivity to preparation components, as well as previous subcutaneous gel injections, silicone, collagen and other implants used for wrinkle filling.^{1,2,4-6,9}

To minimize the risk of possible complications the neurological anamnesis was considered, the required dosing was calculated considering patient’s constitutional peculiarities. Did not allow preparation administration simultaneously with injection implants in one and the same area providing precise preparation injection in the appropriate muscle (m.orbicularis oculi, m.corrugator supercillii, m.frontalis). Moreover, applying botulinum toxin the patients with the tendency towards formation of keloidal and hypertrophic scars were, in particular: commenced treatment with minimum doses and amount of injections in each intervention area, and if required additionally administrated the preparation to achieve required effect.

Botulinum toxin administration method was carried out as follows. The bottle of “Disport” containing 50 OT of botulinum toxin type A directly before administration was diluted with 1.5 ml sodium chloride solution. 8.3 to 16.6 OT of the preparation per one spot was pointwise administered with an insulin syringe with needle diameter of 0.27 in the muscle projection area to be recognized as hyper-active. During procedure the patient was obligatory in vertical position seating on the couch. In general, the total amount of the administered preparation depended on the administration area, wrinkle depth, patient’s sex but not exceeded 150 OT per one procedure. Such method for “Disport” administration in small doses gave us an opportunity to minimize risk of antibodies formation. Upon completion of the manipulation for more equal distribution of the preparation the patient carried out active mimic movements with muscles and has been maintaining vertically up to 4 hours after injection. The patient was recommended not to touch areas the preparation was administered within next 3–4

hours, as well as refrain from physiotherapeutic procedures, sunlight impact, facial massage, sauna within three weeks. ⁹ The degree of clinical effectiveness of the method was assessed by the criteria stipulated by the Classification of facial skin age-related changes of the patient.

Injection administration method for TwAc polynucleotide boosters:

Under impact of tissue ferments PNBPs fall into active components, in particular, adenosine leading to interaction with adenosine receptors (A1, A2A, A2B) of the immune system cells. As a result, the production of inflammatory mediators decreases, effect of pro-inflammatory IL-12, tumor necrosis factor (TNF- α) decrease. Production of IL-10 – potent anti-inflammatory cytokine activates. Hence the proliferation of endothelial cells is regulated and the induction of angiogenesis due to recovery of vascular endothelium growth factor synthesis takes place (VEFG).^{20,29,30,34,35}

Today a leading role is assigned to the PN-based preparations in the biostimulation due to specific influence on fibroblasts.^{24-27,30,33} Long-chain polynucleotide-based gel renders a potent stimulating effect on cell regeneration, metabolic activity and fibroblasts proliferation. Thanks to high concentration and viscosity parameters it may be in dermis for a long time.

Multiple experience of BNC company (Biotechnology Next Challenge, Korea) in the research and production of preparations-bioregenerators, in particular, allowed, by using advanced technologies and evidential base, producing PNBPs-based preparations of new generation in complex with hyaluronic acid of different concentration and molecular weight intended for correction of involuntarily changed facial skin. As a polynucleotide booster a complex preparation TwAc 3.0 consisting of PN 10 mg/ml and GA 20 mg/ml, 1800-2500 kDa, cross-linking 0.02 ppm was used. Injections were carried out with canule technique once in 30 days 2 times. Refresher course of treatment was carried out in 6 months. Manipulation was carried out using local anesthesia with anaesthetic gel EMLA 5%. After procedure heparin ointment was applied to the places of hematoma occurrence.

The assessment criteria:

- ✓ **excellent** (full removal of periorbital static wrinkles and forehead area, and nasolabial furrows by more than 50 %);
- ✓ **good** (improvement without full wrinkle removal, of 30 to 50 %);
- ✓ **satisfactory** (decrease of wrinkle amount in the area of lateral angle of eyes and in the area of nose bridge – to 30 %);
- ✓ **no effect**;

Evaluation of skin colorimetric characteristics by colorimetry method:

We carried out the study of skin covering pigmentation degree and colorimetric characteristics of skin surface using the program Colorimeter (android play market). Colorimetry method is as follows: we measured distribution of color coordinates (L^* , a^* , b^*) of skin area in the zone of cosmetic impact before procedure, immediately after it and in a month by diffusion illumination with standard light sources. Measurement results were interpreted according to the standard colorimetric coordinate system recommended by the International Commission on Illumination ICI 1976 (L^* , a^* , b^*). Furthermore, results assessment was carried out according to chromaticity coordinates of the International colorimetric system – calculating and psycho-physical parameters (Fig. 1).

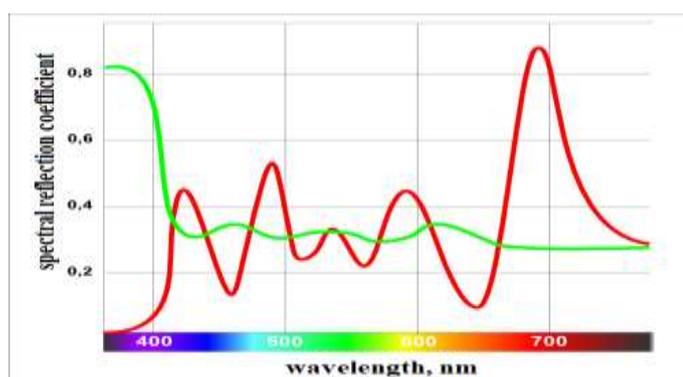


Figure 1: Gray color in different ranges of monochromatic radiation within visible light spectrum.

R, G, B – predominant color determining material color shade (of 380 nm – deep violet, to 780 nm – deep red), R – red, G – green, B – blue; λ – wave length; R_s – Reflection spectrum ration for **R, G, B** (zero to one); L^* , a^* , b^* – space coordinates of the received skin coverings color, L^* brightness from maximum bright to dark and black; a^* space coordinates on the red-green axis (R-G); b^* space coordinates on the blue-yellow axis (B-Y); ΔE general color difference by comparison of two images, by value over 3 the difference of color by human's eye is caught. HUE – color hue, (for example, red, green or medium blue). Vary within 0-360°. Chroma – chroma (saturation of the specific hue, “richness or depth”, less saturated – “dimmed”, close to gray).^{11,12,18} Color of skin coverings depends on combination of plenty parameters including on the level of melanotic pigmentation (sallowness), on percent composition of oxyhemoglobin in studied areas of the skin surface (red hue), etc.^{10,13,15,16,17,19}. Received data were entered in the computer for automated processing.

III. RESULTS:

Statistic processing of the research results:

Statistic processing of the research results was carried out using variation statistics, as well as using application tools - EXCEL, MATCAD, STADIA computer programs. As the result, the comprehensive investigation of facial skin by patients was performed before cosmetic correction of involuntional changed skin for carrying out existed cosmetic procedures and the method of cumulative application of botulinum toxin type

A developed by us and administration of TwAc booster system taking into account individual skin peculiarities. Full scope of the research on facial skin condition was repeated after treatment for objectification the obtained results. The analysis of the estimated parameter accuracy rate $CS=(M/A) \times 100\%$ (where M – arithmetical mean error, A – appropriate average value) showed: this value did not exceed in general 3–5% being significant criterion of correct orientation for statistical assurance of the obtained.

Assessment of skin covering color and spectral characteristics:

Human skin color hue is considered to be one of the principal factors determining its external look. A great number of scientific works are dedicated to skin covering color differences by race and ethnicity. Data of the existed publications has been obtained specifically by studying spectral properties of the skin within one or another part of visible spectrum. Together with that, objective facts concerning color characteristics of the skin under generally accepted and approved ICI colorimetric chromaticity coordinate systems (Fig. 2) are practically unavailable in the literary sources.

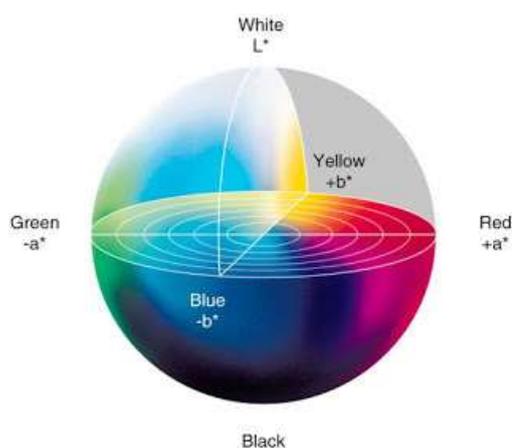


Figure 2: Standard colorimetric coordinate system L^* , a^* , b^* recommended by the International Commission on Illumination ICI 1976.

Along with the development of methods for cosmetic correction of involitional changed skin the necessity in objective analysis of skin color parameters has become evident as the study of colorimetric properties of the person taking into account sex and age-related, race and ethnic, seasonal and regional and psycho-emotional factors allows assuring adequate level of medical-preventive measures in each specific case of the cosmetic treatment.

The statistical analysis of the chromaticity coordinates in the first group showed that before treatment skin shade was determined by the predominant colors R, G, B, simultaneously the predominant was red spectrum within wave lengths 620–644 nm. Data of the first group in general comply with the data of the control group. Visually it looks like a normal skin color, between paleness and faint degree of redness.

It should be either underlined that a significant role in formation of skin shade before treatment and in the control group belongs to light waves within blue spectrum as well, what in total gives the hue in the violet spectrum segment (HUE 10°–40°). Facial skin color chroma is negligible, Chroma 4.2-5.1, stipulated by the peculiarities of the involuntional changed skin (tissue tension is decreased, increased foldings, vascular component is depleted and, as a result, oxyhemoglobin level is decreased). However, immediately after cosmetic intervention color values are being changed which is connected with the hyperaemia appeared after the injection, adema and, in some cases, hematomas^{10,13,15}.

In a month after application of the complex method for correction involuntional changed facial skin the color characteristics had the following properties: facial skin color hue shifted to red segment of the spectrum (HUE 70.9 – 334° and 10 –20° accordingly), color chroma increased (Chroma 5.86–15.21 and 4.26–17.45 accordingly) which characterizes a decrease of skin foldings, increase of oxyhemoglobin content due to microcirculation renewal (Tab. 3). Increase of facial skin forming red predominant component was accompanied by significantly less expressed increase of blue and green colors what is actually gave the shift of facial skin color to red spectrum segment. Increase of chroma, intensity of facial skin color visually looks like shiny fresh skin.

Table 3: Average value of skin chromaticity coordinates by patients of group 1

Subject of research		Chromaticity coordinates						Chroma
Fac e area	Examination n period	R		G		B		
		Rs, s, λ	(x)	Rs, λ	(x)	Rs, λ	(x)	
Gla bella	Before treatment	0. 9	02	0.7 5.	04	1. 0	93	.86
	After procedure	1. 0	05	0.6 54	73	0. 99	74	2.36
	In a month	0. 8	04	0.6 54	82	1. 0	92	5.21

Bucal and malar	Before treatment	0.93	25	0.74	15	1.00	13	.29
		640nm		560nm		490nm		
	After procedure	1.00	75	0.65	41	0.47	42	3.70
		624nm		550nm		472nm		
	In a month	1.00	02	0.70	76	0.50	63	7.45
		634nm		549nm		502nm		

Data represented in Table 3 witnesses about authentic change of the studied chromacity parameters. Data represented in table 3 witnesses about authentic change of the studied chromaticity parameters. Specific interest represents the fact that the dynamics of values among patients of group 1 tended to increase and chromaticity parameter preservation in long dates (in 6–12 months) after procedure.

Consequently, the persons whom TwAc booster was administered significant improvement of chromaticity coordinates in long date after procedure was observed, clinical constituent of which was characterized by the shift of spectral density from blue-violet segment (HUE 334°–358°), as well as intensity strengthening of Chroma (4 to 14) color stipulated by tissue tension improvement and foldings decrease on facial surface area. Visually this fact is defined as “improvement of skin appearance” and is characterized by freshness, i.e. the person looks healthy and good-looking.

IV. DISCUSSION:

Having studied obtained results, we tried to find out scientifically-justified explanations of the phenomenon. During 2013–2018 period there were 1832 published articles on Botox in all fields in PubMed search engine.³⁶ But this research is of definite value due to the innovative methodology on the basis of joint application TwAc booster system and botulinum toxin type A. It is known that in the course of age-related involution chromaticity parameters of open skin coverings of most people undergo significant changes due to physiological fluctuations of melanotic pigmentation level which is in fact stipulates availability of hyper- and hypo-pigmentation on elderly people skin. Definitive influence on the reflective power of each cover has skin surface relief structure: availability of wrinkles, smallpox signs, as well as different neoplasms leading to decrease of integral reflection ration.

Moreover, aging of connective-tissue stroma proteins in the course of photogenesis leads to interruption of enzyme reactions, first of all - oxidative deamination of aldehyde derivatives and oxylysine structures being a component of collagen fibrillas. Naturally collagen modification takes place due to formation of additional stichings between its molecules leading to increase of protein structural and mechanical strength and increase of collagen amount in dermis. According to literary data under the influence of induced UV-light predetermining photoaging process, chromophoric connections are forming in dermis depth coloring its collagen-elastane frame in yellow-brown color.

Consequently, color shade of the involotional changed skin depends both on melanin level in melanocytes and on dermis saturation level with chromophores which are visually perceived in dark-yellow color scale^{16,18,19}.

TwAc booster influence on skin: connective-tissue dermis frame is formed, protein-synthesized skin function intensifies and regional blood flow in tissues due to VEGF factor increases. Under the influence of TwAc booster the level of 10 Interleukin increases having anti-inflammatory effect in administration area. And increase of procollagen and tissue inhibitors synthesis, integration of elastine and collagen fibers with simultaneous increase of proteoglycans predetermines skin “rejuvenating” effect.^{22,23,26,27,29,31-35} Such processes in the collagen structural organization assist in formation of additional chromophoric connections out of natural amino acids – tyrosine, phenylalanine leading not only to growth of color purity index, but also to visible shifts to increasing values of the predominant wave length from blue to red spectrum areas³⁷. These very facts in our opinion are considered to be determinant by explanation of changes in chromaticity coordinates by patients of group 1. No less important parameter showing improvement of skin covering color characteristics is a level of oxyhemoglobin pigment giving the skin pink shade³⁸.

Summarizing obtained results according to survey findings of the focus group from the point of view of skin condition visual assessment the examined patients under one single criterion: “healthy, fresh skin look”, it may be concluded positive effect of the botulinum toxin and TwAc booster complex on skin condition. Before carrying out cosmetic correction facial skin condition according to this criterion was practically at the same level both in group 1 and control group: 10% and 8.3%. In a month after cosmetic correction skin condition in the studied groups became better. For comparison we compared specific weight of all patients with “healthy, fresh skin look” with such in the control group. Diagram (Fig. 3) demonstrates skin condition according to data of visual assessment of patients from both groups within different monitoring periods.

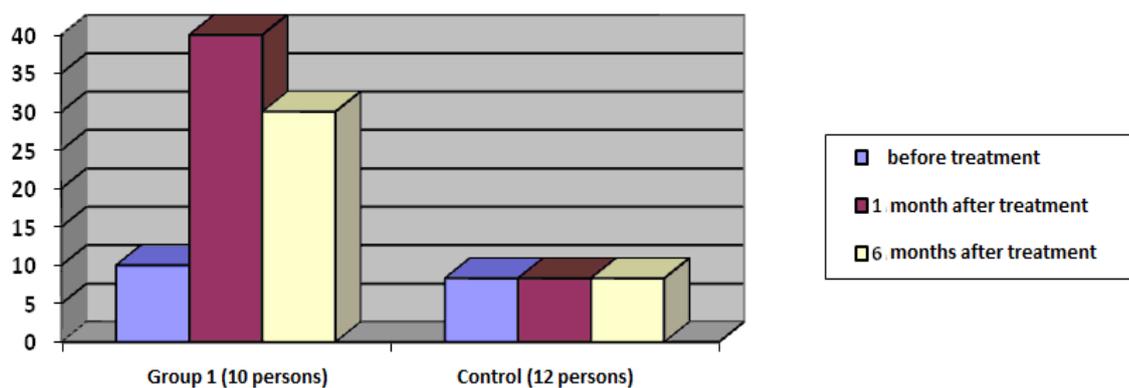


Figure 3: The percent of patients under “healthy, fresh skin look” criterion before treatment and in 6 months after cosmetic correction.

Obviously that the largest percent of patients having satisfactory color indexes make up persons from group 1 in 1 and 6 months after treatment whose color indexes exceeded control and initial indexes in the same group.

V. CONCLUSIONS:

►1. The scheme for optimum doses of botulinum toxin is offered, and method of administration least traumatic polynucleotide-based booster systems has been worked out;

►2. Biological effect synergy of botulinum toxin type A and polynucleotide-based booster systems provides high clinical performance and is considered to be highly-effective, low-traumatic treatment method for involuntional changed facial skin and may be used in mass dermatocosmetological practices;

►3. Colorimetric properties of involuntional changed facial skin are considered to be following criteria:

- Principal face color shade shifts towards violet spectrum area (HUE 10°–40°);
- insignificant color depth (Chroma 4.2–5.1);
- reflection low level stipulated by decreased tissue tension, increased foldings, depleted skin vascular component, increased content of melanin agent and oxyhemoglobin decreased level.

►4. Application of complex correction method for involuntional changed facial skin in long dates after procedure (1 and 6 months) provides significant improvement of chromaticity coordinates: spectral density shift from blue-violet segment (HUE 10°–40°) to red-yellow spectrum segment (HUE 334°–358°), color depth increase (Chroma of 4 to 17.7) preserving within long dates (in 6–12 months) after procedure. Visually it is expressed as “healthy, fresh skin look”.

Conflict of interest

The author declares no conflict of interest.

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