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# APPLICATION OF CARBOXYTHERAPY IN COSMETOLOGY

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**Abstract**

Today, carboxytherapy is an innovative direction in medicine for the treatment of many diseases, as it is able to act on an extensive pathological symptom complex, which can be explained by the multifunctional participation of CO2 in many metabolic and reflex processes of systemic self-regulation of the body. CO2 acts as an intermediary, triggering cascades of natural mechanisms of regulation of all organism systems (respiratory, transport, nervous, cardiovascular, excretory, hematopoietic, immune, humoral, etc.). Carboxytherapy has become a real breakthrough in modern cosmetology and aesthetic medicine, we can call the "old" know-how with effective therapeutic and aesthetic potential. Around the world, carboxytherapy has become a very popular, promising and natural way to regenerate the skin and rejuvenate it. This therapy is a type of mesotherapy, where physiological carbon dioxide is used as an administered drug. After a course of carboxytherapy, the skin tone increases by 15-20%, which is comparable to the results of plastic operations. The local effect of carbon dioxide in invasive carboxytherapy on a limited area of tissues is accompanied by stimulation of chemosensory cells, an increase in volumetric blood flow, and an increase in the rate of oxygenation at the site of CO2 administration. Consequently, fifty years of experience in the use of carboxytherapy in cosmetology proves its safety and effectiveness in aesthetic problems such as early aging of the skin, correction of stretches, streaks, scars, dim complexion, edema or dark circles under the eyes, hair loss, pigmentation, modeling of the figure, as well as in pathologies such as lipodystrophy, eczema, local sclerodia. According to statistics, carboxytherapy is best performed in patients over 30 years of age, since the practical experience of its application confirms that in young patients the result is more effective for longer periods.

Thus, carboxytherapy has upended the laws of beauty and youth, since the desired effect of rejuvenation is achieved with the help of "harmful" but physiologically necessary carbon dioxide.

**Keywords**: *carboxytherapy,* carbon dioxide, *cosmetology*

Today, carboxytherapy is an innovative direction in medicine for the treatment of many diseases, as it is able to act on an extensive pathological symptom complex, which can be explained by the multifunctional participation of CO2 in many metabolic and reflex processes of systemic self-regulation of the body. CO2 acts as an intermediary, triggering cascades of natural mechanisms of regulation of all organism systems (respiratory, transport, nervous, cardiovascular, excretory, hematopoietic, immune, humoral, etc.) [1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11]. All these vital systems of the body play an important role in maintaining its homeostasis. With low levels of CO2 and bicarbonates in the blood, the body ceases to function normally and it disrupts the cascade of natural biochemical reactions to restore homeostasis.

Carboxytherapy has become a real breakthrough in modern cosmetology and aesthetic medicine, we can call the "old" know-how with effective therapeutic and aesthetic potential. Around the world, carboxytherapy has become a very popular, promising and natural way to regenerate the skin and rejuvenate it [12, 13, 14]. This therapy is a type of mesotherapy, where physiological carbon dioxide is used as an administered drug. After a course of carboxytherapy, the skin tone increases by 15-20%, which is comparable to the results of plastic operations.

The local effect of carbon dioxide in invasive carboxytherapy on a limited area of tissues is accompanied by stimulation of chemosensory cells, an increase in volumetric blood flow, and an increase in the rate of oxygenation at the site of CO2 administration. Subcutaneous injections CO2 cause local moderate alkalosis, which promotes analgesic and antispasmodic effects; local hyperemia, oxygenation which is accompanied by bactericidal (especially for aerobic microorganisms) and anti-inflammatory action. At the same time, tissue perfusion is improved due to vascular dilatation, reparative and metabolic processes are enhanced, and receptor sensitivity is restored. Tissue in the injection area CO2 receives a powerful incentive for regeneration, supported by the activation of the body's own resources. As a result, tissues are restructured after several carboxytherapy procedures (Fig. 1) [26].

The same pharmacotherapeutic principle is used to treat the diabetic foot. Increased CO2 delivery to the exposed zone increases the release of nitric oxide, which leads to an increase in oxygen content and blood flow to the exposed foot tissue. Improved angiogenesis and oxygenation, promote ulcer healing (anti-inflammatory, reparative action) [3, 1].

Simultaneously with the activation of blood circulation and the strengthening of metabolic processes at the site of carbon dioxide introduction, the function of skin fibroblasts affecting the synthesis of collagen, elastin and hyaluronic acid is stimulated. These three components are responsible for the condition of the skin and other tissues: the larger they are, the better the skin looks. Fibroblasts, in addition to collagen formation, are interferon producers that are involved in providing bactericidal and anti-inflammatory effects [27].

Introduced subcutaneously or intracutaneously CO2 is distributed in certain directions, but gradually its diffusion becomes more uniform, which indicates a decrease of fibrous dermatological and cosmetological defects (striae, stretches, scarring) and achievement of homogeneity of supporting dermis tissues [28, 29].

Under the influence of stresses, unbalanced nutrition, hormonal disorders and other pathologies, atrophy of hair follicles occurs. The task of carboxytherapy is to "wake" (activate) sleeping follicles. After the CO2 injection into the problem zone of the hair cover, blood supply, oxygenation and nutrition of hair follicles are increased (Figure 2). As a result, hair growth restores. To achieve this effect, carboxytherapy must be combined with the intake of vitamins, trace elements, amino acids [30, 31].

Thanks to a rich pharmacodynamics of carboxytherapy on the place of CO2 injections, diverse local pharmacological effects in skin are observed:

- stimulation of angiogenesis and process of oxygenation in skin;
- stimulation of skin and capillaries regeneration (their number increases, they extend, the capillary blood-groove accelerates), disposal of toxins;

- anti-aging effect (strengthening of cell regeneration process, elasticity and tone of skin increase);
- lifting and smoothing of wrinkles;
- improvement of structure and quality of skin;
- reduction of puffiness and increase in turgor of skin around eyes;
- suppression of a melanogenesis;
- clarification and alignment of skin color (toning);
- deep skin restructuring and moistening;
- recovery of skin immunity, inflammation removal (acne, rozatsea);
- minimization and prevention of post acne scars;
- destruction of the bacteria causing post acne scars growth;
- improvement of skin condition at psoriasis;
- reduction fat tissue;
- strengthening of function of sweat and sebaceous glands;
- restoration after insolation and cosmetic procedures [32, 33, 34].

Carboxytherapy favourable effect at cellulite, which mechanism is in detail considered above is confirmed by obvious changes of appearance of problem sites zones.

At cellulitis and local obesity zones $CO_2$ stimulates processes of a lipoliz, reduces local fat deposits, improves blood circulation in fat tissue and at the same time promotes reduction of puffiness and signs of body skin aging, improves venous outflow, intensifies removal of toxins from an organism, increases skin elasticity and also stretches elimination is observed [35].

All listed effects of carboxytherapy on a skin condition promote not only improvement, but also updating and clarification of an organism, increase in immunity and working capacity, normalization of work of internals, improvement of quality of life.

The marketing analysis demonstrates that carboxytherapy found effective application in many fields of medicine, but especially wide experience of its application is accumulated in cosmetology and dermatology. Today carboxytherapy is an innovative modern method by means of which the esthetic medicine achieves good results. $CO_2$-therapy is solution for many cosmetology problems: when signs of skin aging appear, help to improve body shape (before and after the procedure), for many cosmetic defects elimination (extensions, hems, dark circles, wrinkles at a lipodistrofiya (cellulitis)), and other skin pathologies, also for protection of an organism against harmful physical and chemical factors.

Connecting skin tissue (actually dermis) carries out protection against mechanical damages too, and blood vessels perform function of thermal control, food, transport, etc.

Important organism marker, which indicates age of the skin, especially on a face, a neck and hands. Skin – the first area of body protecting an organism from influence of harmful factors of the external environment. Skin consists of many layers. The corneal layer of epidermis which carries out protection of an organism against harmful physical and chemical factors is outer.

The lymphatic skin system makes an essential part of the immune system of the person and plays a significant role in the mechanism of immune protection. Therefore skin, thanks to the listed components, takes part in the following functions of an organism: protective, respiratory, immune, synthetic (synthesis of enzymes and mediators), temperature-controlled and a metabolism, secretory (clarification of an organism from products of metabolism and excess water), etc.

Besides, according to the German scientist S. Shmits, the functional condition of internals and systems can indirectly be reflected in skin therefore any violations of a homeostasis respectively can have skin manifestations.

Skin condition is influenced by age, the polluted ecological environment of the cities, bad habits

(smoking, alcohol), some hereditary diseases (ichthyosis, diabetes, atopic dermatitis), non-compliance with quality and a diet and dream. All this in total serves as the prime cause of many pathologies of bodies and systems, including cosmetology problems: eels, a couperosis (very dry skin), early aging of skin, an extension, a lipodistrofiya, psoriasis, eczema, scars, dim complexion, hypostases or dark circles under eyes, a hair loss, etc.

In cosmetology one of frequent indications for CO2-therapy application is rejuvenescence (correction of wrinkles, hems, pigmentation, enlarged pores of skin and other indications), improving body shape. At these indications the enhancement from carboxytherapy is observed in more than 75% of cases [36].

Aged up to 25 years skin is as elastic as possible, it has rather high ability to fast regeneration. By 30 years the level of elastin and collagen of skin decreases by 25%, to 40 – for 50% and wrinkles appear actively, decrease in turgor and elasticity of skin on a chin and cheeks becomes noticeable, by 50 years can skin under eyes can become saggy and pigmentary spots can appear.

After 60 years, wrinkles deepen (elasticity and elasticity decrease), thickness (tuberosity, smoothness) and skin pattern (strengthening) change, skin color becomes thick (pigmentation, sunny lentigo, gray-yellow tint, etc. (Fig. 3), skin moisturization (dryness, areas of exfoliation), increased activity of sebaceous glands; microcirculation changes (vasculature on the surface of the skin and its pastosity manifests). All of the above is the result of aging the body and skin. In addition, in menopausal women, the skin actively loses its natural qualities due to hormonal shifts, hypoxia, ischemia, weakening of dermis tissues, impaired microcirculation of small vessels. Therefore, the elimination of wrinkles must begin from the moment of their appearance, and not wait till situation get worse. Therefore after 25 years skin needs deep moisturization, care and help [37].

To **rejuvenate** face and body skin can be used such effects of carboxytherapy as vasodilation, oxygenation and rapid rebalancing of intracutaneous collagen, elastin and hyaluronic acid are most often used. The result of carboxytherapy does not make you wait long and is clearly visible after 2 procedures or over the next 7-14 days. But correcting the shape of the lower eyelid, double chin correction, as well as rejuvenating, requires more carboxytherapy procedures and time. At a young age, the use of carboxygel masks can be an alternative to invasive carboxytherapy, as well as a good addition to enhance the result. Therefore, carboxytherapy in cosmetology and aesthetic dermatology allows solving skin problems of different etiology caused by hypoxia, quantitative and qualitative violation of collagen fibers, processes of vascularization, regeneration and restoration of aesthetic skin.

**Dark under eyes circles and swelling** are frequent problem for both women and men. The formation of dark circles under the eyes can be caused by the following etiological factors: age pigmentation of the skin, deformation of the nasolacrimal canal, but most often this is associated with poor blood circulation in the lower eyelid, tissue hypoxia in this area and metabolic disorder.

Intracutaneous, subcutaneous injections of $CO_2$, as well as the additional use of carboxygel (Figure 4) in the eyes area can reduce dark circles under the eyes, completely remove ederma (with excessive fluid retention in the adipose tissue of the ocular area), can eliminate wrinkles around the eyes, restore skin elasticity, face form, young and fresh skin. In this face area $CO_2$ -treatment normalizes cellular metabolic processes (antioxidant action), which in turn contribute to the prevention of excessive spontaneous lipid peroxidation [38]. In addition, $CO_2$ increases cellular immunity, has an anti-stress property and regulates the process of vitamin D assimilation which involved to skin pigmentation process.

In cosmetology, carboxytherapy is believed to be one of the few methods to eliminate dark circles around the eyes that successfully replaces surgical blepharoplasty. In particular, the use of carboxytherapy in the area of the lower eyelids gives a good result: the skin becomes dense due to the stimulation of collagen formation and a decrease in the volume of subcutaneous fat; swelling under the eyes decreases due to improved vascular microcirculation, vasodilation, increased tissue oxygenation, as a result of which wrinkles smooth out, dark circles decrease or completely disappear (Fig. 5) [17].

**Stretches** located on the chest, abdomen, thighs, buttocks are serious problem faced by women at a certain age. These defects appear more often due to hormonal disorders, a sharp increase or weight loss and in pregnancy. Stretches are also the result of excessive stretching of the skin and destruction of collagen fibers, elastin and a lack of hyaluronic acid. Under the influence of carboxytherapy the synthesis of these three components is improved, skin density and elasticity are increased, the cosmetic appearance of stretches is significantly improved, which makes their edges almost invisible against the background of normal healthy skin. Over time, the stretches may decrease, and in the future they completely disappear (Figure 6) [18, 19].

**Striae** are special form of scar tissue, that are formed as a result of damage (ruptures) of collagen and elastin fibers. Striae are very poorly treatable by any cosmetological correction methods. Neither popular retinoid therapy, microdermoabrasion (micro-grinding), nor laser skin resurfacing have a significant effect. In addition, laser therapy is unsafe for people with smug skin (as it can increase skin pigmentation) or be dangerous if there is a predisposition to cancer. In turn, invasive and non-invasive carboxytherapy is an accessible, effective and safe (for all skin types) method of treating new and old striae by restoring the structure of collagen and elastin fibers [20].

Positive patient feedback, clinician observations of the carboxytherapy effects on striae elimination are observed in more than 90% of cases (Figure 7).

After first procedures Carboxytherapy improves the condition of **scars** of various types (acne, to a lesser extent traumatic and postoperative) due to the fact that $CO_2$ injections enhance local vascularization, oxygenation, contributing to improved microcirculation in the scar tissue area (Figure 7). In cosmetological clinics successful correction of post acne scars are performed by ablative fractional rejuvenation with $CO_2$-laser [21, 22].

According to optical profilometry, the effect of carboxytherapy in post acne scars (moderate to deep) improves their texture by 25-50%, and 67% of patients show an objective decrease in the depth of scarring.

Analysis of statistical data shows that the condition of scarring in acne, photoaging improves in an average of 74% of cases after 3 months of treatment: (acne-scarring by 83%, with photoaging by 67%). As a rule, carboxytherapy after 1-2 procedures improves skin condition in scarring of various types (Figure 8) [23].

Carboxytherapy stimulates **skin hair follicles** by introducing SO2 into the blood of head tissues and improving local circulation, which leads to induced vasodilation and oxygenation of both the scalp in general and hair follicles in particular. Therefore, this method is used for reducing hair loss, their slow growth and **alopecia** (baldness), areata (focal alopecia), androgenetics (with an increased concentration of testosterone in the blood): male-type baldness - spinning strands in the central sampling zone and in lateral areas; after burns, as well as in onychoclasia (increased fragility of nail plates) [24].

Etiological factors for the development of alopecia can be neurological or severe local and systemic infectious diseases. For many patients, hair loss is primarily a psychological problem, so patients are looking for all possible methods to combat this pathology. The use of carboxytherapy allows eliminating alopecia not only due to improved microcirculation and oxygenation of skin in the scalp area and directly the hair follicle bag, but also due to its reparative, anti-inflammatory, antihypoxant and antioxidant properties $CO_2$ (Fig. 9) [2].

**Localized (focal) scleroderma** is not very common, but for patients it creates significant aesthetic problems. Conventional treatments are vasodilators and physiotherapeutic procedures, such as laser irradiation and local cream therapy. To date, there has been little information about the use of carboxytherapy in this disease, most likely, such a treatment experience is casuistic, since there are no studies of large groups of patients. However, even here for carboxytherapy, there are indications and experience of application: improving the aesthetic appearance of the skin with intracutaneous injections directly into the foci. Clinical observations showed that no signs of recurrence of the disease were observed for three years after the course of carboxytherapy [25].

Due to antihypoxic, antioxidant and reparative properties, increased vasodilation and angiogenesis,

local carboxytherapy allows improving the microcirculation of the skin, which affects the process of restoring cells and hair follicles.

In cosmetology, the alternative to invasive carboxytherapy is non-invasive. The basic principle of the latter remains the same: skin rejuvenation is achieved due to the physiological and pharmacodynamic properties of carbon dioxide, but special masks and skin gels that contain $CO_2$ are used for this.

In cosmetology, the alternative to invasive carboxytherapy is non-invasive. The basic principle of the latter remains the same: skin rejuvenation is achieved due to the physiological and pharmacodynamic properties of carbon dioxide, but special masks and skin gels that contain $CO_2$ are used for this.

Recently, carboxytherapy has become one of the most popular treatment methods for **lipodystrophy (cellulitis)** in the West. More than 95% of women note the presence of cellulite, which is often associated with a change in the level of female sex hormones - estrogens. In addition, with age, the number of collagen and elastin fibers in connective tissue decreases markedly, there is a violation of peripheral blood supply, various changes in the hormonal background, and in combination with eating and sleep disorders, a sedentary lifestyle, bad habits (smoking, alcohol), frequent stresses and abrupt weight changes, first leads to the formation of dimples and bulges ("orange crust"), and with the aggravation of lymphostasis to the accumulation of toxins and the emergence of cellulitis itself. Carboxytherapy in lipodystrophy eliminates congestion associated with impaired circulation by improving microcirculation, vasodilation, excretion of toxins and lipolysis products. Fat cells are burned under the influence of oxygen, which is part of carbon dioxide, while the remaining structures of the skin and nervous tissue remain unaffected.

Carboxytherapy is a procedure widely used in all stages of cellulite. Extensive clinical experience over 50 years has confirmed that in the fight against lipodystrophy and local obesity, carboxytherapy is a very effective procedure. It provides mechanical destruction of fat deposits due to $CO_2$ pressure on them, elimination of lymph stagnation and as a result of toxin elimination. When assessing the local effect of carboxytherapy on adipose tissue, the positive effect of $CO_2$ on the oxidative lipolysis process was established. Carboxytherapy is also prescribed after liposuction to eliminate skin relief. Only 10-15 sessions for make the skin smooth and tightened (Figure 10).

Consequently, fifty years of experience in the use of carboxytherapy in cosmetology proves its safety and effectiveness in aesthetic problems such as early aging of the skin, correction of stretches, streaks, scars, dim complexion, edema or dark circles under the eyes, hair loss, pigmentation, modeling of the figure, as well as in pathologies such as lipodystrophy, eczema, local sclerodia. According to statistics, carboxytherapy is best performed in patients over 30 years of age, since the practical experience of its application confirms that in young patients the result is more effective for longer periods.

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**Figure 1.** Effect of $CO_2$ on microcirculation in the skin
(increased number of capillaries, improved microcirculation)

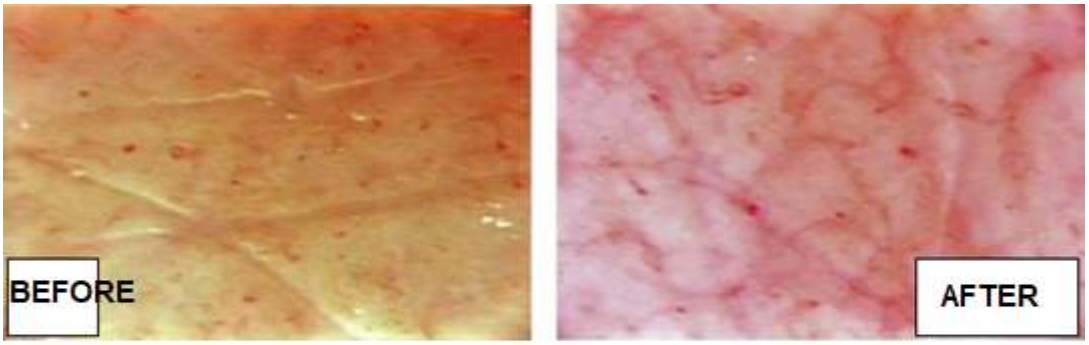


**Figure 2.** Effect of carboxytherapy on hair growth

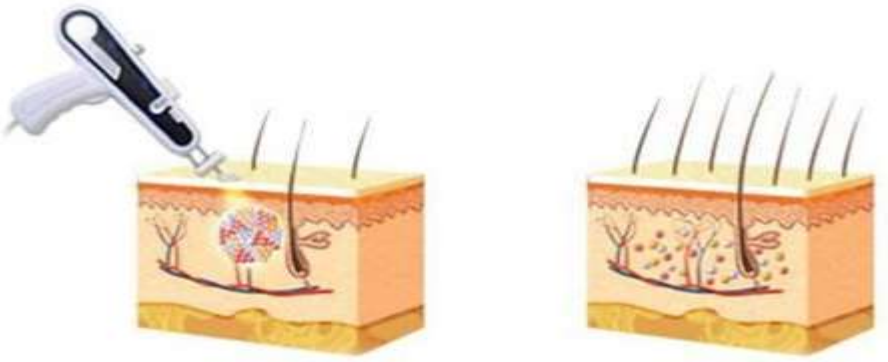

**Figure 3.** Age solar lentigo

**Figure 4.** Condition of the facial skin before and after carboxytherapy

**Figure 5.** Reducing dark circles under the eyes, increasing skin elasticity and reducing hyperpigmentation


**Figure 6.** Skin (stretches) before and after carboxytherapy

**Figure 7.** Skin (stretch marks) before and after carboxytherapy


**Figure 8.** Appearance of scar before and after carboxytherapy

**Figure 9.** Possibilities of carboxytherapy in alopecia

**Figure 10.** Cellulite before and after 11 and 19 sessions of carboxytherapy