



*PROSPERITAS VESTRA FINIS NOSTRA!*

**MEDICAL UNIVERSITY  
"PROF. DR. PARASKEV STOYANOV"  
VARNA**

**FACULTY OF MEDICINE  
DEPARTMENT OF INFECTIOUS DISEASES, PARASITOLOGY AND  
DERMATOVENEROLOGY**

Dr. Julian Zlatkov Penev

**LASER RESOURCES FOR FACIAL REJUVENATION AND  
AESTHETICIZATION**

ABSTRACT OF A DISSERTATION

Scientific specialty "Dermatology and Venereology"

Doctoral program: "Skin and venereal diseases"

Professional field: 7.1 "Medicine"

Field of higher education: 7. Health and Sport

Supervisor:  
Dr. Ilko Bakardzhiev, Ph.D.



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The dissertation contains 233 standard typewritten pages and is illustrated with 188 figures, 2 graphics, 7 tables, and 6 appendices, containing additional photographic documentation, references to previous contributions, publications, and participation in scientific forums. The literature reference includes a total of 105 literary sources, of which 20 in Cyrillic and 85 in Latin. The dissertation was discussed and scheduled for the official defense by the Department of Infectious Diseases, Parasitology, and Dermatovenereology at the Medical University - Varna. The public defense of the dissertation will take place on ..... in an online session from ....., before a scientific jury composed of:

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Abbreviations and acronyms:

J - Joule

W - Watt

LFDA - Laser Fast Draw Ablation

OSA - One-Shot Ablation

CO2 laser - a laser with an active medium of carbon dioxide

DPN - Dermatitis Papulosa Nigra

Er: YAG - erbium laser

Nd: YAG - neodymium laser

BCC - basal cell carcinoma

ALA – aminolivolinic acid

## 1. INTRODUCTION

The present dissertation focuses on laser therapy of dermatoses located on the head and neck with a carbon dioxide laser. These include dermatoses that are difficult to treat with therapeutic methods or scarring after them is aesthetically unacceptable to the patient - acne, multiple seborrheic and solar keratoses, hyperpigmentation, hemangiomas, keloids, scars after burns, trauma, and surgery. Removal from the face of signs of aging skin (fine lines, deep wrinkles, elastosis, and melasma). For all these dermatoses there are classic methods of treatment (surgical excision, electrocoagulation, cryodestruction, dermabrasion, thermocoagulation, radiotherapy). In all of them, the destruction cannot be precisely controlled, the clinical effectiveness is variable and depends on the experience of the operator, and the aesthetics of the end result is not prioritized and predicted. Plastic facial surgery corrects sagging problems and wrinkles in aging skin, but does not change its condition - just tightens it. The outcome of a surgical facelift is highly dependent on subjective factors and the end results are not always predictable and sometimes even grotesque. The same risks exist in the application of relatively new approaches with hyaluronic fillers, as the effect of them is at least temporary, but they also do not improve the structure and condition of the skin, but only temporarily swell it.

The effects of new lasers and other energy-intensive hardware effects have not been sufficiently clinically studied. The methods for conducting therapeutic procedures with them have not been optimized or specified in clinical protocols. Moreover, the market encourages the development of new systems, with a tendency for spontaneity in the emergence of new models without sufficient study of their effectiveness. Dermatological lasers on the market are no exception. The effectiveness of laser systems and the therapeutic range of procedures with them are often overexposed and create conditions for unrealistic expectations, both in the patient and in the attending physician. The spontaneity of indiscriminately applied techniques and procedures without in-depth biophysical justification and lack of sufficient experience poses risks of harm or, at best, of low therapeutic efficacy. Insufficiently detailed models of the biophysical interactions of laser light with the skin have not been developed.

All this requires the physical models of interaction of laser light with tissues to be considered in a biophysical aspect, supported by extensive clinical experience. This experience and the created biophysical models allowed the optimization of therapeutic techniques that allow the removal of single and multiple pathological lesions without rough scarring and maximum aesthetics of the end result, which is especially important when it comes to the face.

This paper is an experience of the author - a pioneer in the application of laser devices in dermatology to summarize his own, more than 30 years of clinical experience in the treatment of various dermatoses and procedures that improve the appearance and condition of aging skin. The possibilities for application of CO2 laser in the therapy and aestheticization of facial skin are analyzed, comparing and analyzing photo-documentary material from own clinical practice and optimized therapeutic techniques in order to achieve maximum aesthetics of the end result.

## **2. PURPOSE, TASKS, AND HYPOTHESIS**

### **Purpose**

To optimize, analyze and summarize the therapeutic options for aestheticization and rejuvenation of facial skin with laser effects with specific techniques and typical clinical cases in anatomical areas of the head - capillary, eyelids, ears, lips, nose, and neck.

### **Tasks serving the purpose:**

1. To make theoretical and biophysical substantiation for optimization of the processes of ablative impact.
2. To analyze the types of laser effects - ablation, excision, thermolysis, and resurfacing by determining their therapeutic effectiveness on conditions and dermatoses associated with unsightly appearance and old age: seborrheic keratoses, solar and senile dyschromia, precancerous dermatoses, skin dermatoses of skin elasticity (elastosis) and rhytids.
3. To analyze laser therapeutic techniques in anatomical areas of the head and neck.

4. To analyze the author's laser procedure for effective treatment of adult and prolonged juvenile acne and erasure of its scars.

5. To analyze the possibilities for optimization of ablative laser resurfacing through an author's biophysical model.

6. To analyze statistically the changes in self-esteem reflecting the subjective quality of life after aesthetic laser procedures of a control group of patients.

7. To specify and formulate conclusions and recommendations for clinical use (clinical protocol).

### **Hypothesis**

By optimizing the laser effects (ablative, thermolysis, and fractionated) non-aesthetic formations can be removed from the face without rough scarring, improve the structure and elasticity of the skin and achieve visible and lasting rejuvenation, which positively affects self-esteem and hence quality of life.

To realize the goal and tasks of the dissertation and test the hypothesis, methods of comparing photo-documentary material with the evaluation of the results in the short and long term are applied. The effectiveness of the considered effects is validated by statistical analysis of psychological parameters of self-esteem after laser aestheticization and facial rejuvenation.

The subject is laser exposures and therapies for the treatment and aestheticization of facial skin. The subject of this paper is the analysis and summarization of my own clinical experience in laser-based methods for aestheticization and rejuvenation of facial skin and their therapeutic range for real application and potential. These methods include the removal of unsightly dermatoses, such as those associated with old age, as well as effects that improve the turgor and elasticity of the skin and rejuvenate it. The relevance of the dissertation stems from the understanding of the importance of the quality and appearance of facial skin as an important factor for self-esteem and social life, confidence, and self-realization of the individual. Eliminating the visible signs of aging, and removing unsightly dermatoses and those associated with old age can actually increase self-esteem and quality of life. The significance of the dissertation is determined in theoretical and practical terms.



### **3. MATERIAL AND METHODOLOGY**

This paper analyzes the possibilities for the application of CO2 laser in the therapy and aestheticization of facial skin, comparing and analyzing photographic material from our own clinical practice. The therapeutic efficacy is compared with the effectiveness of other methods known so far on this issue and discusses the approaches developed to achieve maximum aesthetics without compromising therapeutic radicalism with the techniques used and described here:

1. Laser Fast Draw Ablation (LFDA);
2. Speed Shot Ablation (OSA);
3. laser excision and incision;
4. laser thermolysis;
5. fractionated ablative laser resurfacing.

The results of aestheticization and rejuvenation of the skin allow analyzing the changes in the self-esteem of patients as a function of these results. Therapeutic-aesthetic effectiveness is analyzed statistically by assessing psychological parameters before and after therapy on a control group of patients. Therapeutic and aesthetic removal of non-aesthetic dermatoses and skin rejuvenation were performed by laser fast draw ablation (LFDA), one-shot ablation (OSA), laser excision, and deep laser resurfacing. Participants fill out a psychological questionnaire of 2 self-assessment modules:

1. Self-assessment of appearance - self-assessment scale, consisting of 11 items. The construct measures the subjective assessment of satisfaction with one's own bodily appearance. The subjects were self-assessed on a scale from 1 to 5, with 1 corresponding to the lowest degree of the measured characteristic, and 5 - the highest degree. The respondents mark their answers on a scale from 1 to 5, with 1 being "Never" and 5 "Almost always";

2. Overall self-esteem with 10 questions from the scales attitude towards yourself and social confidence. Respondents score their answers on a scale of 1 to 5, with 1 being "very common" and 5 being "almost never".

Statistical analyzes were performed with IBM SPSS Statistics.

### **3.1 Therapeutic methods and techniques used**

All therapeutic systems based on CO<sub>2</sub> laser have a wide range of output power settings, single pulse length, and pause between pulses required mainly for surgical work in deep skin incisions. For aesthetic work on the skin, most modes of known laser systems are unnecessary and can even be dangerous. These unnecessary operating modes can confuse the operator, delay settings, or demotivate the dermatologist due to their complicated control. This paper describes practically applicable techniques that have a simple setup and can be applied to any CO<sub>2</sub> laser system available on the market. The effectiveness of these techniques has theoretical and practical confirmation in extensive clinical experience. Experimentally proven physical models have been created in which the parameters of the skin and the laser are defined in a scientifically sound context in order to optimize the laser impact. This optimization is the result of many years of monitoring the effectiveness and control of the actual physical parameters of the laser - power density, energy density, pulse length, focal spot size, and depth of impact. Methods for aesthetic removal of various skin dermatoses were optimized with the application of a pulsed laser (superpulse, ultrapulse) laser. Laser ablation is optimized as a therapeutic effect in two defined techniques:

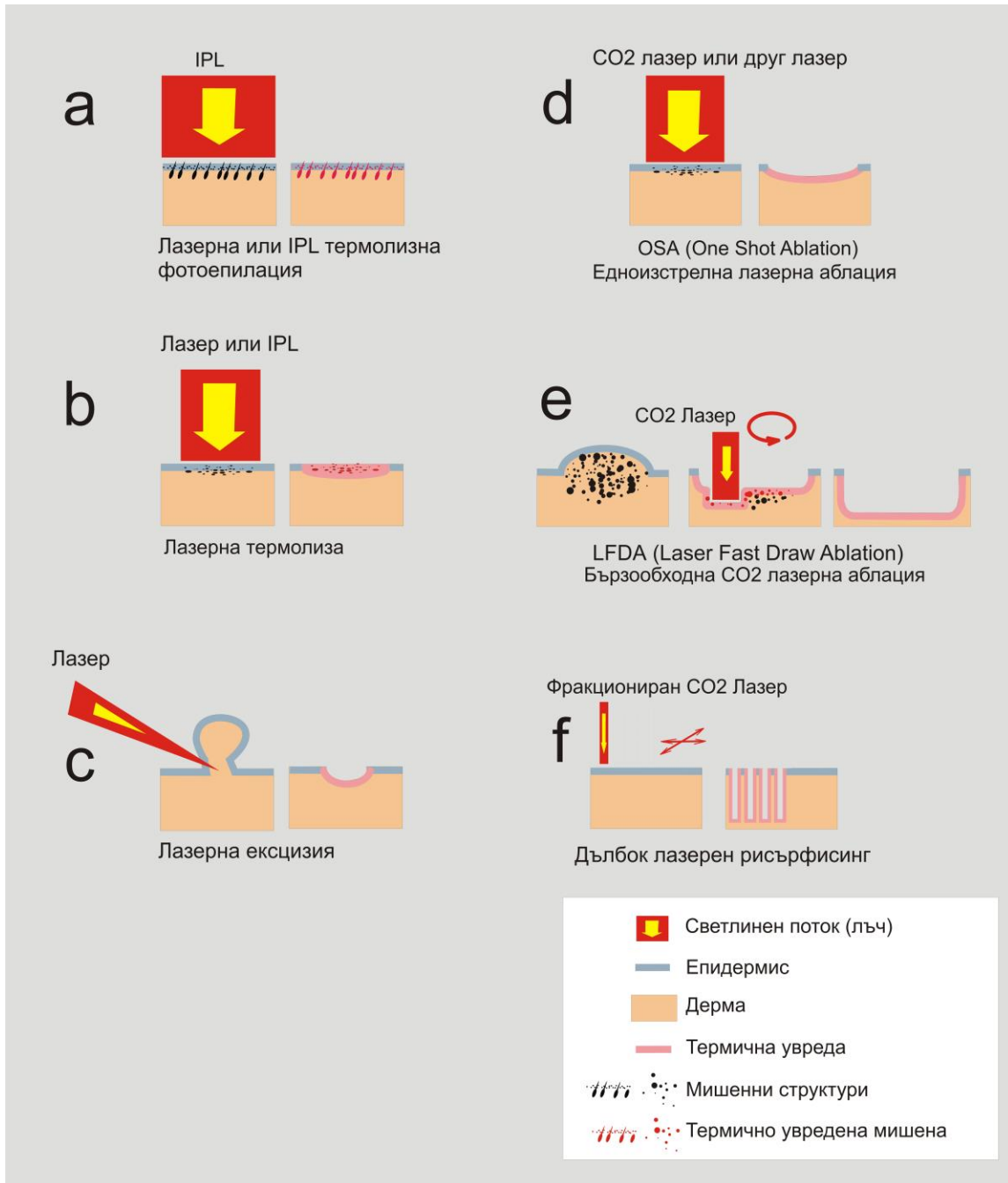
- Laser Fast Draw Ablation (LFDA);
- One-Shot Ablation (OSA).

These techniques are based on the model of laser thermoradiation self-limited ablation.

#### **3.1.1 Laser Fast Draw Ablation (LFDA) and one-shot ablation (OSA)**

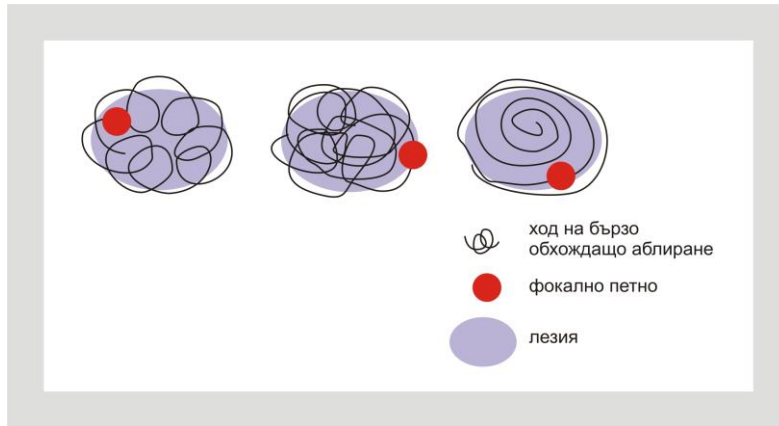
The term laser thermoradiation self-limiting ablation was first formulated here. This process has a specificity that requires detailed study because it involves not only the physical properties of tissue water - high heat capacity, low boiling point, and high absorption index of 10600 nm. The water included in the cellular structures radically changes the physics of the interaction, forming the phenomenon of the observed thin-layer tissue ablation. This phenomenon is most likely related to the cellular microexplosive transition process, which briefly thermally insulates the

underlying layer due to poor thermal conductivity of water vapor, endothermic nature of water vapor, and high peak power of laser pulses limiting thermal irradiation in depth. The thermal radiation temperature heats the underlying layers to a denaturing thermal level, but this is done in a relatively thin layer. If the heating continues, the self-limitation of the thermal irradiation is stopped due to the reduction of the water included in the cells in the thin thermolysis zone below the already ablated layer. In order not to lead to excessive thermal radiation at depth, the beam simply moves and thus the entire surface of a lesion can be treated with minimal thermal load at depth. With the rapid movement of the focal spot, the ablation is transferred to an adjacent area, and the previous one begins to cool thermorelaxatively. In this way, a volumetric pathological lesion can be curetted in layers throughout, circumferentially and rapidly, layer by layer, without undue thermal stress, as would be the case if the entire volume or area was heated to thermolysis or ablative levels, to achieve which requires a high output power of the laser.



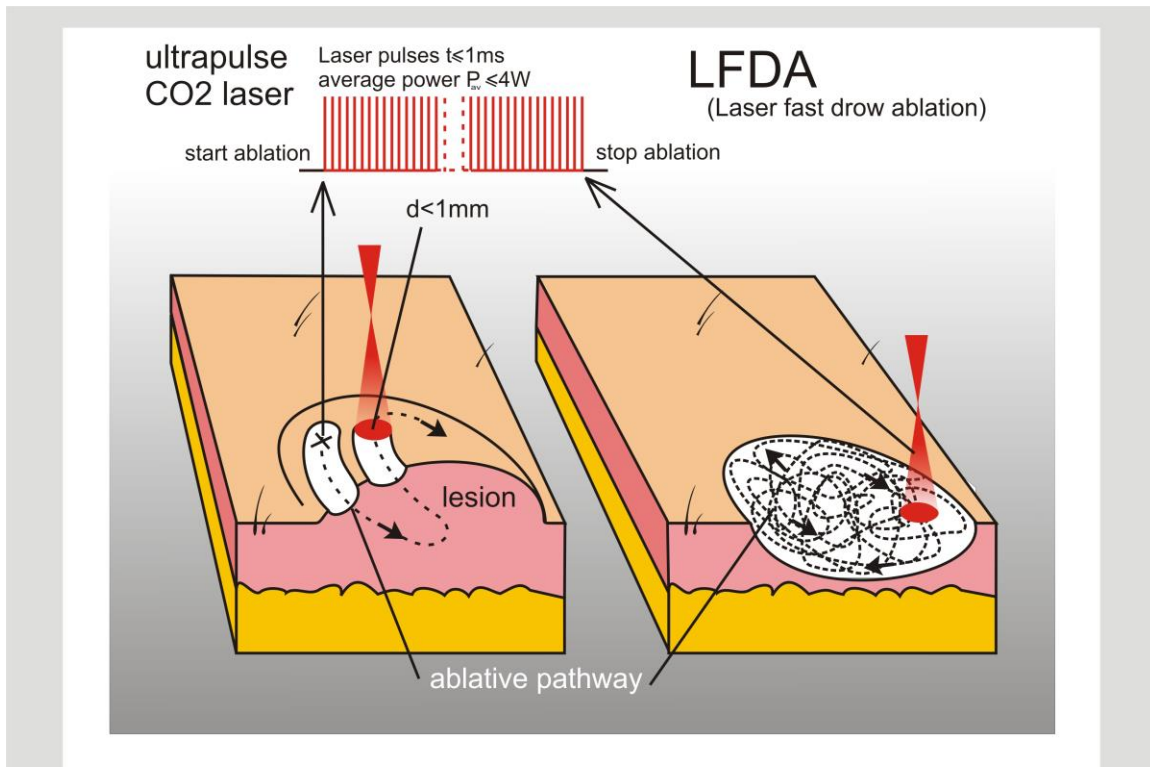
**Schematic representation of the types of laser effects.**

In both techniques, the output average laser power is set to the lowest possible value, at which effective ablation is observed at a focal spot below a millimeter (0.6-1 mm). With this small focal spot the volumetric lesion must be removed by traversing quickly according to the demonstration scheme, at the speed of rapid handwriting.

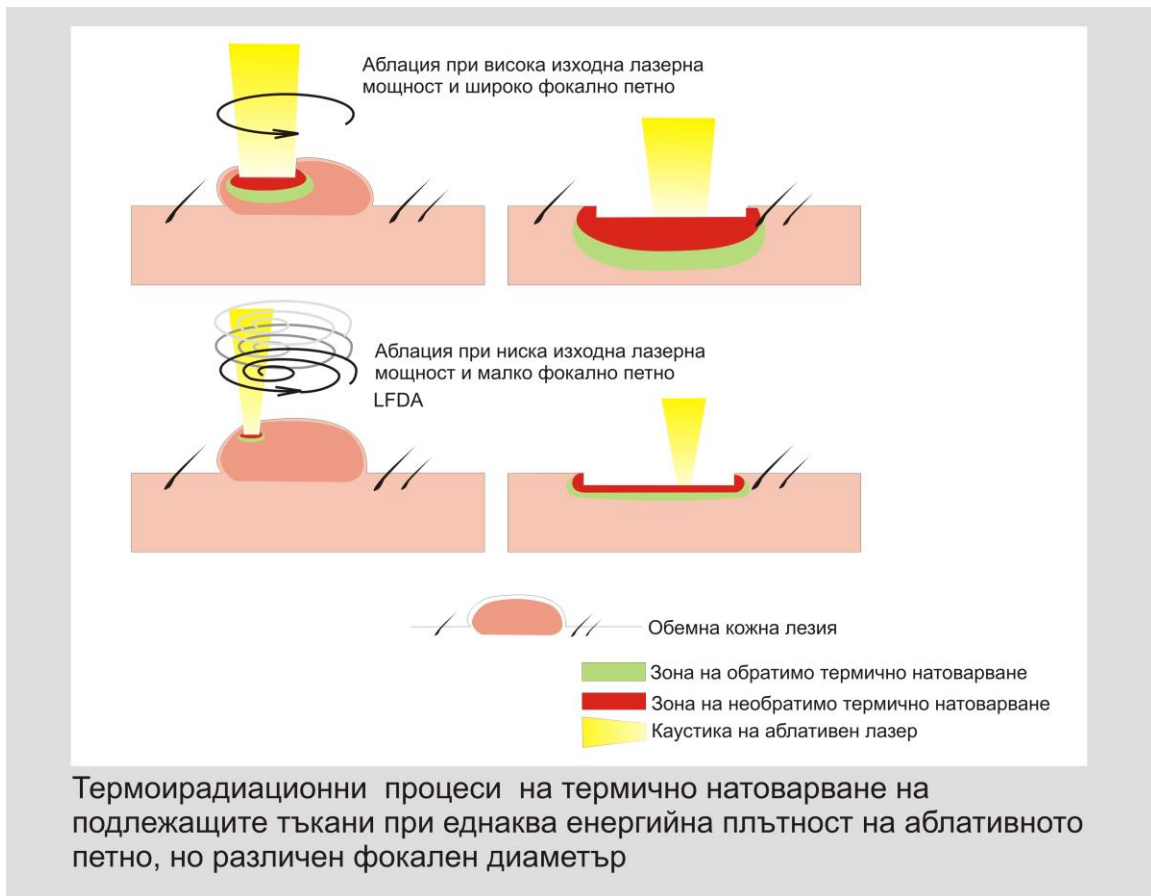


**Stroke of the ablative laser spot on the surface of the lesion providing minimal thermoradiation load of the underlying layers**

In this way of work, the energy load in a small ablative spot is minimal and before ablative energy enters it again, it has time to effectively cool thermorelaxation. It is with this approach that maximum thermal sparing of the underlying layers is obtained and a bulky lesion can be removed with minimal risk of rough scarring.



**Ablative removal of a bulky lesion with a small focal spot (<1 mm) and fast drawing.**

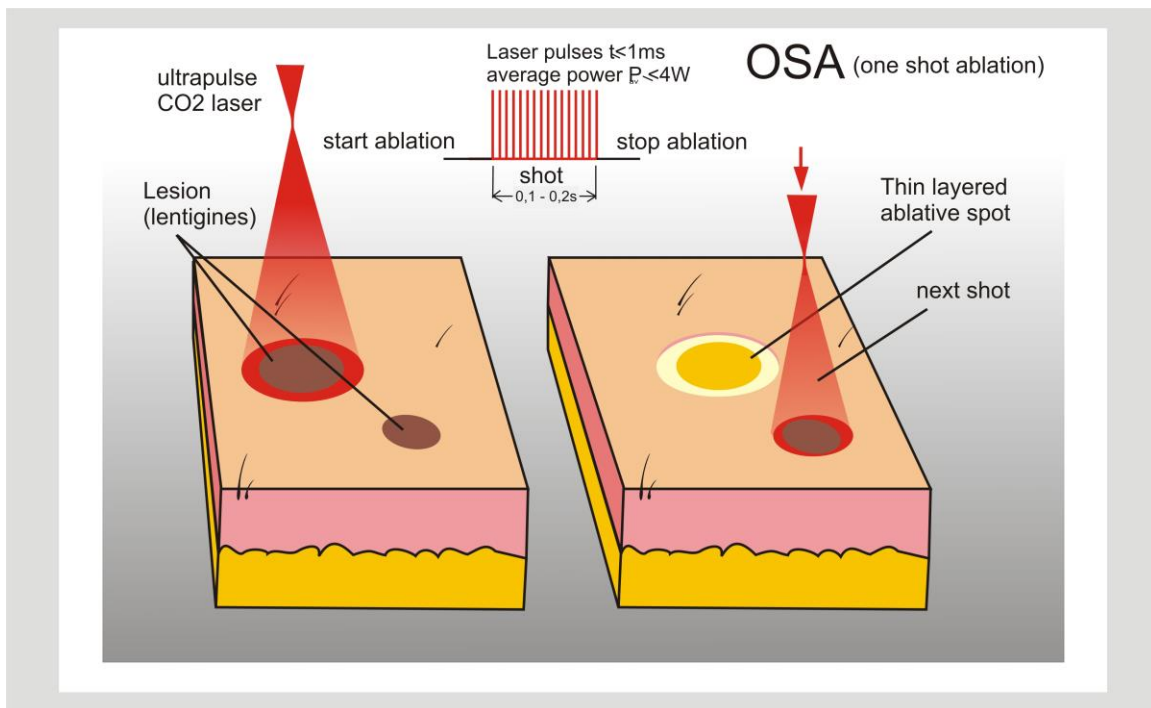


**Schematic representation of ablative removal of a bulky skin lesion at the same ablative power density, but with different output powers and focal spot size. In the first case, the ablation is performed with a high laser output power and a wide focal spot, and in this mode the thermal load of the underlying healthy layers is significant. In the second case, the ablation has the same density power, but it is achieved by reducing the focal spot and the laser output power, whereby the thermal load on the base is significantly reduced.**

In this way of ablative treatment carbonization processes are completely avoided. Carbonization reduces ablative efficiency and introduces uncertainty into thermorelaxation processes. On the other hand, working with such low laser output powers allows the rapid ablative crawl technique to be combined with the one-shot technique to remove small and superficial lesions in the vicinity, thus achieving a high therapeutic rate. This speed is extremely important when it comes to multiple small lesions (tens and hundreds) that compromise skin aesthetics as a whole. Both techniques

are applied at the lowest possible output power of the CO<sub>2</sub> laser, which causes ablative effects in a small focal spot (<1 mm). For laser output powers up to 4W and focal spots between 0.5 and 0.9 mm, ablative power densities between 500 and 2000 W / cm<sup>2</sup> are provided. In this range, the ablation can be performed at different speeds, as the visual control of the process allows to adaptively select the optimal processing speed. The low laser output power ensures that no overdose will occur in-depth and provides a relatively wide range of traversing speeds.

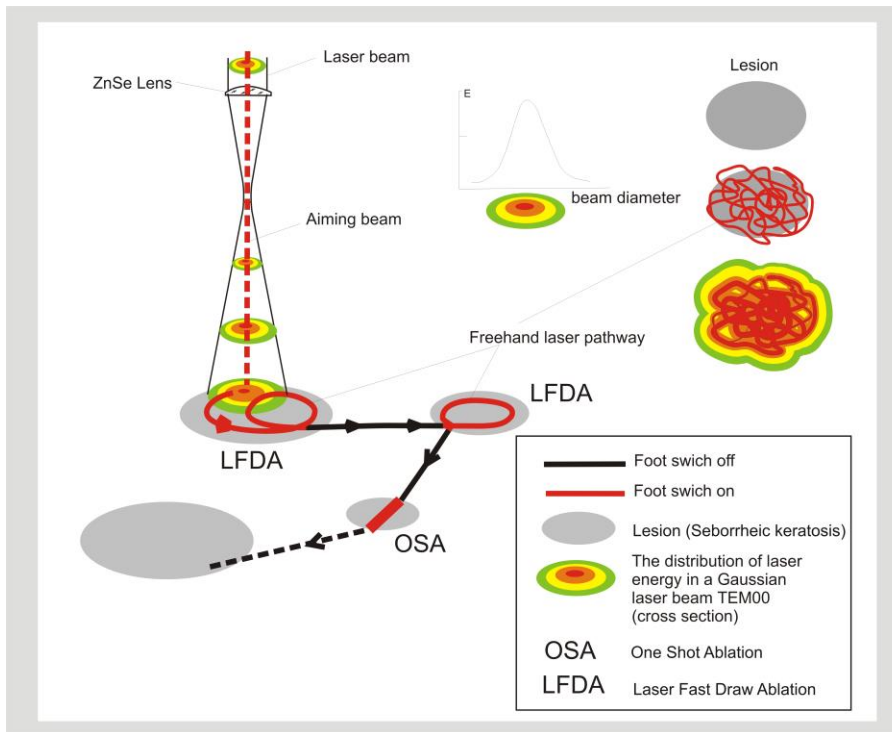
In one-shot (OSA) technology, the laser impact is controlled only with the operating pedal. At first glance, it seems that this way of making a mechanical pulse introduces inaccuracy and subjectivity in the laser impact, but practice proves that this is not the case. With a very short pulse the small lesion will undergo thermal destruction, and with a slightly prolonged pulse will reach a delicate superficial ablation, which in both cases will not be associated with gross scarring characteristic of overdose and high laser output. The energy in a short pulse produced by the working pedal is in the range between 200 to 2000 mJ (0.1 - 0.5 sec) and in focal spots between 1 and 5 mm energy densities sufficient for surface thermolysis or thin-layer ablation can be realized. in lesions with a diameter between 1 and 5 mm.



**Schematic illustration of one-shot laser ablation**

In this therapeutic approach with both therapeutic techniques, it is essential to perform a follow-up examination in which missed or residual benign lesions are removed mainly with a one-shot (OSA) technique. This is easy because these residual structures become clearly visible against the background that is already clear from the first procedure. The described techniques are suitable in the removal of multiple seborrheic and solar keratoses, epidermal and dermal nevi, DPN, solar lentigo, papillomas, and cherry angiomas. Unsightly single dermal nevi are treated only with the LFDA technique, and those that are pediculed are excised high above the base in a tweezers-pulled state, after which the base is ablated. Removal of all non-aesthetic lesions on the face and neck is mandatory before the procedure of deep laser resurfacing to tighten and rejuvenate the face as a whole.

The described techniques are especially suitable for novice laser operators because the risk of aggressive overdose is minimized and the technique with the accumulation of clinical experience can be defined as the acquisition of calligraphic writing.



**Schematic illustration of the course of the laser beam using both techniques in the rapid ablative removal of different sized lesions.**



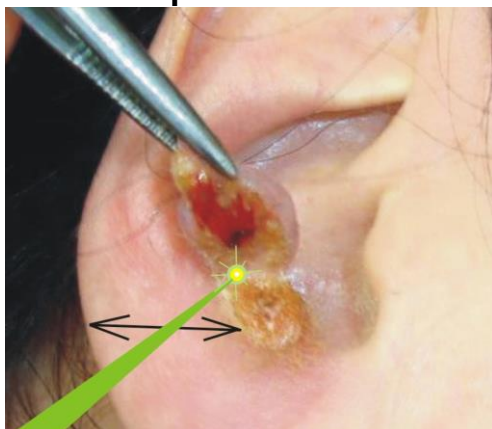
For more than 30 years of clinical practice and monitoring of recovery processes after the removal of various dermatoses, clinical protocols for therapeutic behavior have been developed in order to maximize therapeutic and aesthetic effectiveness of results, shorten the recovery period and reduce the likelihood of complications for each dermatosis and area. from the face and body.

### **3.1.2 Laser excision and incision**

Laser excision is essentially a surgical procedure. Laser excision is suitable for the removal of all pediculous benign lesions, those that protrude and are broad-based, and can be removed with tweezers - fibroids, papillary dermal nevi, verrucous nevi, and exophytic growing seborrheic keratoses.



**Two months before, and after laser excision of two dermal antitragus nevi. Therapeutic radicalism and aesthetics are categorical.**



**Stage of laser excision of the nevi from the previous photograph. The direction of cutting the lesion high above the base when pulling with tweezers is indicated. Immediately after the excision, the edges and the base are ablatively sculpted according to the geometry of the antitragus.**



**Laser excision of a verrucous formation for histological examination. The material taken by laser excision is completely suitable for histological examination. The lesion was removed firmly and the wound surface was ablated. Appearance of the scar, of histologically proven benignity, 1 month after lesion removal (3rd photo, below).**

Laser excision is very similar to the shaving technique of surgical biopsy. Skin incisions (cuts) can also be made deep inside and below the dermis to reach and remove foreign bodies, fatty cysts, atheromas, and cutis osteoma. Epidermal cysts (atheromas) are reached with a laser incision. Their epithelial capsule must be removed with tweezers and excised at the base after the evacuation of the dehydrated contents, thus their treatment is definitive. The atheroma capsule is removed through a small hole that does not require suturing, and after epithelialization the scar formed is invisible.



**A 40-year-old patient with atheroma behind the ear (a); withdrawal of the epidermal capsule and its laser excision (b); view of the laser section after removal of the cyst (c). The cut is so small that there is no need for a seam. Appearance one month after the procedure (d). Delicate, barely noticeable scar, without expression of threads. Erythema in the area is transient and will subside in the coming months.**



**The laser incision is especially suitable for removing foreign bodies in the subcutaneous tissue. The photo shows a case of traumatically damaged skin after a car accident. The patient underwent a skin-smoothing procedure and in the meantime pieces of tempered car, glass were found, removed through a delicate laser cut.**

### **3.1.3 Laser thermolysis**

In this mode, the lesions are treated with low power densities and wider focal spots (> 1 mm) in order to heat the tissue above the thermolysis threshold (above 50oC). The aim of this impact is to damage the lesion irreversibly thermally in a short time so that the thermal radiation damage to the underlying cellular structures is minimal.

To obtain a thermolysis effect using 10600 nm, the power density is in the narrow range between the effect of ablation and the effect of reversible heating and is determined by the water content of the target and the energy density. CO2 laser thermolysis differs from that obtained in lasers operating

in the visible and near-infrared spectrum and is always associated with epidermal necrosis, and according to energy density, thermolysis is achieved at different depths of the upper dermal layers. This regimen is particularly suitable for the removal of multiple thin-layer superficial epidermal lesions such as solar lentigo, small seborrheic keratoses, dermatosis papulosis nigra, flat warts, mollusks, and also superficial dermal lesions such as cherry angiomas, telangiectasias, and hemangioma.

At dosed energy density, the underlying tissues under the lesions are reversibly heated and remain vital, which ensures rapid epithelialization and aesthetics of the end result. Clinical follow-up shows that no such signs remain after such thermolysis, and the observed hypopigmentation after single dosing is reversible. The required working power density is determined in the course of work only by changing the focal spot, so that when reproducing the shortest shot with the working pedal (0.1-0.2 sec) and a focal spot covering the lesion, no epidermal ablation, but only visible fading accompanied by a slight crack. This acoustic effect, characteristic of laser ablation, is also due to a micro explosive process that causes steam intercellular vacuolation at the dermo-epidermal border, where the water content is higher. This process also limits the rate of thermal radiation and short-pulse thermolysis is self-limiting in a very thin layer. The laser power must be set to low levels (2-4 W superpulse or ultrapulse) and provide a power density below 100 W / cm<sup>2</sup>. Of course, in this mode, some lesions will undergo ablation of the epidermal layers, but this will not create an epithelialization problem associated with gross scarring. The two techniques of one-shot thin-layer ablation and thermolysis are identical and are part of the OSA technique and allow rapid removal of small and multiple lesions in the most aesthetic way possible.

#### **4. RESULTS AND DISCUSSION**

The carbon dioxide laser has long been used for ablation of skin lesions, but existing methods do not discuss techniques for optimizing the process itself, ensuring predictability and aesthetics of the end result. Techniques to have physically justified support for the ablation process and how to make it as gentle as possible for healthy tissues.

The dissertation systematizes effective methods of CO<sub>2</sub> laser effects, really improving the appearance and condition of facial skin - studied, applied, and optimized by the author with more than 30 years of clinical experience. For optimization of the laser impact, new biophysical models of interaction of light with the tissues have been defined, allowing optimization of the therapeutic and aesthetic effectiveness of the laser impact. In the dissertation work, an attempt is made for the evolutionary anthropogenic interpretation of skin pathology. The evolutionarily advanced potential of the skin's natural regenerative capabilities and protective functions is analyzed.

All new lasers in the entire spectral range have been studied in an effort to maximize the effectiveness of various dermatoses. In these studies, attention was paid mainly to high selectivity, as the importance of wavelength was demonized to the extent that a special laser was required for each dermatosis. Scientific staggers toward selectivity have ultimately created advanced laser and IPL photoepilation devices, where the idea of high thermolysis selectivity works. In this case, the biophysical model is relatively simple - small pigmented targets at the same depth in a relatively homogeneous environment. In bulky dermal and epidermal lesions larger than 1 mm, this theoretical model collapses. The larger the target, the longer the thermorelaxation time is prolonged, and the diameter of the thermoradiation damage increases.

The present paper revises this prevailing view in laser dermatological propaedeutics that wavelength is most important for the removal of dermal lesions. The principle of the importance of spectral selectivity (wavelength) is applicable only to the removal of superficial small capillaries or hair follicles. In laser hair removal, the physical principle is the destruction or damage of small targets (hair follicles), placed evenly, at the same depth, in the heat-intensive environment of the skin. In this case, the physical model of light selectivity does work, but the hair removal procedure itself should not be the subject of serious dermatology.

To optimize the processes of ablative impact, own physical models were created, considered and discussed in the dissertation. Through various exposure techniques such as laser excision, rapid laser ablation (LFDA), one-shot ablation (OSA), CO<sub>2</sub> laser can be used to effectively, quickly and

aesthetically remove many benign lesions from the face and whole body, thus eliminating the need for the application of different lasers operating at different wavelengths.

Many skin lesions have an epidermal location or affect the upper layers of the dermis. Adopted surgical techniques for their removal, affecting the deep dermis, carry risks of rough scarring and unsightly end result, which is especially important when the lesions are on the face. In surgical removal of lesions, the imposed sutures are ischemic to the dermal layers, which negatively affects the natural regenerative processes. The resulting fibrous connective tissue subsequently almost always creates a visible scar atrophic, hypopigmented or hypertrophic, and sometimes rough and keloid in nature. Of course, some larger dermal lesions and those of dysplastic and aggressive neoplastic nature must be surgically removed, but if after surgery a rough scar is formed, it should be known that it can be effectively aestheticized at a later stage with laser ablative or resurfacing procedures. In laser ablation, a phenomenon of weak or absent irritative inflammatory reaction around the wound bed is observed, which is due to coagulation obliteration of vessels and sealed ends of nerve endings. The wound surface remains dry, painless and calm, and if it is not irritated with bandages or ointments, it is not impetiginized as the inflammatory shaft formed around it is minimal or absent. The regenerative processes of the skin are quite large, but are often underestimated and rely on medication, which in most cases interferes with these processes. My clinical experience has shown that when the wound surface remains concave below the level of the surrounding skin due to the need for radical removal of the dermal lesion and the site of impact is left free epithelialization, then after recovery there is no defect with tissue loss (sagging). A faint, slightly hypotrophic scar is formed, which over time becomes difficult to notice and even pigments normally.

In all these methods of action, the wound surface is left to free epithelialization, protected by the thin sterile coagulation crust formed after the procedure. Surgical interventions require sutures that not only ischemize the tissues, but also interfere with revascularization processes, and after healing, a visible scar and impression are often formed from the tightening of the sutures or pulling.

Sometimes a surgical scar can be very noticeable or "relax", because during surgical procedures the deep dermis is always cut. In areas of extension, immature and already damaged dermal connective tissue stretches and forms an unaesthetic wide atrophic hypopigmented scar. The signs of such an unwanted complication after surgery are always hypopigmented and noticeable, and due to the absence of melanosomes there is a risk of UV-induced neoplasia in the future.

Aesthetics of this type of post-surgical defects can be performed with the methods of laser ablation and laser resurfacing. These manipulations aim at retraction of the scar tissue and its smoothing. After surgery, another side effect may be observed - keloid reaction. It is a serious cosmetic problem, especially when it comes to the face, neck and décolleté, and these are the predominant areas for the appearance of this pathological connective tissue hypertrophy. Elimination of this side effect is also done by laser ablation and laser resurfacing, before that the keloid must be premedicated to the extent of controlled skin atrophy with intralesional injection of depot corticosteroid triamcinolone acetonide (Kenacort, Kenacort, Kenac). The injection is intralesional at various levels every few months until skin atrophy occurs, after which the scar is remodeled with the aforementioned laser techniques.





**A large nevus on a broad pedicular base above the upper lip, which gradually increases in size due to the presence of a large number of swollen sebaceous glands in its stroma. The size of the lesion impairs the aesthetics of the face and the presence of large comedo-structures poses a risk of inflammation in it. Surgical excision was refused due to the risk of pulling and breaking the symmetry of the lips (a, b). View of the wound surface immediately after laser excision and ablation of the base (c), the depth of the ablated base being approximately 3 mm. At the follow-up examination after a month there is still a slight pink, but without loss of tissue. The oral symmetry is not broken, and the small dermal nevus left above the nasolabial fold gives charm to the facial expression (d).**

## **4.1 Results and discussion of laser therapy of the most common non-aesthetic dermatoses**

### **4.1.1 Seborrheic keratoses**

Seborrheic keratosis is a benign lesion and in extremely rare cases can metaplasize or rather overlap a precancerous lesion or neoplasm. Rapid eruption of multiple lesions may be associated with a neoplastic process (Leser-Trélat sign) and is described as part of the paraneoplastic syndrome. After removal of the neoplasm, keratoses remain and negatively affect the already shaky mental status of cancer patients.

Patients delay the removal of this benign dermatosis for various reasons and it often reaches large sizes. Expressed on the visible parts of the face, seborrheic keratoses impair facial aesthetics. A person with multiple keratoses looks neglected and aged. The common name "age spots" really creates the idea of premature aging in others. Research data show that seborrheic keratoses negatively affect self-esteem, and hence social performance and communication. In addition to an aesthetic problem, seborrheic keratosis creates discomfort and can worsen the quality of sleep due to the itching experienced, especially during the summer months, during exercise, provoking sweating, and impetiginization of lesions. Patients are forced to mask these unsightly formations with make-up products, but due to their volume and prominence, the lesions always remain visible even after professional make-up. Attempts are being made to eliminate cryo-destruction, which cannot be dosed in an objective way but relies on subjective judgment. Hyperkeratosis on the surface of the lesion isolates the thermally underlying layers of the lesion because it is poorly thermally conductive. This undermines the therapeutic efficacy of cryotherapy. Electrodestruction is another option, but it also carries the risk of gross or visible scarring. The surgical approach to removing these unsightly epidermal lesions is the most unjustified, but it continues to be practiced and even taught. It is important to note that not all lesions can be removed surgically, especially when they are multiple manifestations. Surgical removal always damages the deep dermis and the lesion is markedly epidermal. There is a risk of postoperative loosening of the suture, and the formation of extremely unaesthetic hypopigmented and hypotrophic scars.

The result always refuses the patient to continue such a therapeutic approach, especially when the lesions are multiple, and often refuses to remove them. In addition to the existing risks of impetiginization and gross scarring, there is also a risk of keloid formation. The surgical procedure is slow. During the time the surgeon washes his hands and puts on gloves, hundreds of lesions can be removed on an outpatient basis with the high-speed laser ablation described here. The surgical procedure is expensive, requires support staff, and consumables and through it, in practice, a large contingent of those affected cannot be covered and high social efficiency can be achieved. There is also a method of therapy with photosensitization with alpha livolinic acid (ALA) and subsequent light irradiation, but the therapy itself is unnecessarily long and the achieved therapeutic results can be assessed only as variable and ineffective.

In all of the above methods there is a risk of gross scarring, in which, in practice, one defect can be replaced by another. Last but not least is the risk of late detection of a malignant pigmented lesion in the presence of multiple seborrheic keratoses throughout the body. Patients cannot detect and distinguish a rapidly growing pigmented lesion when it is hidden among a variety of seborrheic keratoses that persist for years and that the patient is accustomed to because the GP or other physician has told them that these lesions are not dangerous and do not need from treatment.

A properly performed ablative laser procedure using the techniques described herein allows the removal of this dermatosis without noticeable scarring. The accumulated clinical experience and the synthesized author's clinical protocol provide the most effective therapeutic behavior in the laser removal of multiple and large seborrheic keratoses.

Laser fast draw ablation (LFDA) allows the treatment of large lesions, and one-shot ablation (OSA) allows the removal of small lesions at a high therapeutic rate. In one session, the lesions can be removed completely and without visible or barely noticeable scars. The step-by-step approach allows the removal of even lesions with an area of several tens of square centimeters. Dozens, even thousands of lesions can be removed in one treatment session. The manipulation itself is outpatient, fast and after it, no postoperative care is needed. The only condition is that the treated area does not get wet for at least a week. When epithelialization is performed under

the cortex, the area of laser-sterilized ablation is usually non-inflammatory and epithelialized rapidly and does not even require antiseptics in the area before and after the procedure. Impetiginized lesions are usually treated after the inflammation has subsided.



**A 68-year-old patient with Leser-Trélat sign after successful cancer treatment. Lesions give a matte appearance to the skin and negatively affect self-esteem and social performance. They are removed with ablative laser techniques without rough scars.**



**A 80-year-old patient with multiple sebaceous keratoses giving a neglected and aged face. The lesions were removed in two sessions. Facial appearance two years after the procedure (second photo).**



**A 64-year-old patient with advanced seborrheic keratoses on the forehead and capillaria creating an aged and run-down skin, removed in several sessions. The patient postponed their removal for fear of surgery.**

When the lesions on the face are multiple, a unilateral approach is applied in their removal, removing the large (above  $d > 1$  cm), medium ( $d < 1$  cm), and small (1-3 mm). Simultaneously with the treatment of seborrheic keratoses in the selected half of the face or body can be removed and other concomitant benign lesions (angiofibroma, papillomas, solar keratoses, solar lentigo, telangiectasia, sebaceous hyperplasia, xanthelasma, angiomas and synergy, angiomas and syringoma). This approach is both to stimulate the patient to continue their therapy and to appear for a check-up to revise missed lesions or residual lesions in the treated facial area. Large lesions are removed gradually, for better and faster epithelialization, without the risk of impetigo. examination, which is an important condition for avoiding overdose associated with rough and noticeable scarring. In people with sunburn in the first year, a hypopigmented spot can be observed at the site of the removed plaque, which disappears after the summer months. When removing larger and neglected lesions, a permanent hypopigmented scar may remain, and in such cases, the patient is warned to avoid sun exposure so as not to increase the contrast with the scar on the one hand and to provoke new lesions on the other. If hypopigmented or atrophic scars form after laser ablation, it is most likely due to excessive overdose or subsequent impetigo. Impetiginization can occur most often when the patient ignores postoperative requirements, such as not wetting the treated area, not mechanically removing crusts, and not premedicating. With proper laser

ablation and postoperative care, even very large seborrheic keratoses can be removed without visible scarring.

An important stage of laser therapy itself and part of the clinical protocol is informing the patient about the need to change their behavioral stereotypes in skincare in order to avoid the appearance of new lesions: reducing hyper hygienic habits; avoiding underwear with rough seams; scrubs, sponges and brushes; avoid prolonged hot baths and swimming pools. Of particular importance is the reduction of sun exposure. This part is perhaps the most difficult because changing the stereotypes created in childhood and behavioral copying often meet with skepticism and negativity. No new lesions were observed in patients who really changed their behavioral stereotypes, which is another confirmation of the hypothesis presented here about the etiology of seborrheic keratosis.

The accumulated clinical experience and the comparison of the results with other therapeutic approaches and the obtained results define laser ablation as the most effective, fast, and aesthetic means for removal of seborrheic keratoses without risk of postoperative complications. The photo-documented long-term results and the feedback from the patients at the check-ups are indisputable proof of this ultimate therapeutic and aesthetic effectiveness.

#### **4.1.2 Nevi**

The extensive clinical experience presented in this paper validates the results of laser ablation, excision, and thermolysis of dermal, non-dysplastic nevi before and after therapy. The presented results refer to the removal of dermal nevi without dysplastic features that violate facial aesthetics or those that significantly affect psychological comfort.

Congenital dermal nevi that are protruding and pediculous should be removed with CO<sub>2</sub> laser excision, with or without local anesthesia. The procedure is very similar to a shave biopsy - the scalpel is replaced with a laser scalpel, but the wound surface can be further ablated. The excised material is completely suitable for histological examination and only in the immediate vicinity of the laser section a thin 100-200 µm unstructured zone with thermal destruction of cellular elements is observed. All cellular

elements in the stroma of the removed lesion remain intact and even the vessels remain blood-filled due to their instantaneous coagulation closure.



### **The widespread misconception that the laser manipulation material cannot be histologically examined.**

Melanocyte nevi that are at the level of the skin or slightly protrude, after a detailed assessment of the accepted macroscopic risk criteria (ABCDE) and analysis of dermatoscopic criteria can be safely and effectively removed by laser ablation and protruding, pediculous, and papillary can be laser excised and examined histologically at discretion. It is widely believed that nevi cannot and should not be removed or "pushed". Such claims exist not only in the neighborhood epic, but have become an unfounded medical dogma that only surgical excision is the "solution" to remove them. Very often lesions that have nothing to do with moles (nevi) are defined as such - warts, keratoses, solar lentigo, fibroids, angiofibroma.

The field for the removal of this dermatosis has been taken over by the surgeons, who jealously guard this area and determine this easiest manipulation for them as the only therapeutic option. It is never discussed that with surgical removal there are a number of risks of complications, formation of unaesthetic scars, keloids, loosening of the suture, tissue loss, and symmetry. On the other hand, there has been a misconception that nevi cannot or rather should not be laser removed because of the likely possibility that non-nevi cells will remain intact in-depth and undergo malignant degeneration. This view has never been scientifically proven or confirmed in any way and has been superficially interpolated by the therapeutic approach to melanoma malignum. A calm melanocyte nevus cannot undergo malignant degeneration without the involvement of proven mutagenic factors - high-energy UV or gamma radiation. The CO<sub>2</sub> laser generates 10600 nm in the far-infrared spectrum. In this range, photons are low-energy, and even nonlinear two-photon absorption cannot cause an a priori ionization mutagenic effect. Malignant melanoma in most cases (70%) arises from a melanocyte cell in normal skin in solar-laden areas, and the 30 percent that falls on its occurrence in the nevus has a purely statistical explanation, due to the significantly higher density of melanocytes ) cells in one mole.

Extended clinical experience with the use of CO<sub>2</sub> laser for the removal of unwanted melanocyte nevi on the face has proven that this therapeutic alternative is not only inferior to surgery but also has a number of advantages. The aesthetic end result is better and the risks associated with surgical excision are less. The formed scars are delicate and inconspicuous or absent. With a properly laser-ablated nevus, the scar formed over time pigments normally and leaves no permanent hypopigmented spots or visible edges, and if there are any, they are easily corrected ablatively at follow-up. With laser ablation, all benign pigmented lesions can be removed completely, even all over the body, especially when they are abundant, which facilitates the need to monitor the occurrence of risky pigmented lesions, and purely the statistical risk of future degeneration is reduced by eliminating the huge number of clustered melanocytes. With this approach, a new lesion will be easily noticed against the general clean background. When the lesions are small and multiple, their surgical removal is



impractical and even impossible. A total nevectomy at an early age reduces the statistical risk of metaplasia of melanocyte-saturated lesions due to the fact that they simply do not exist. In patients with a proven predisposition to keloids or those who have received keloids after surgical removal, those removed by laser ablation of adjacent nevi epithelialize without risk of keloid scarring. This process has been analyzed and confirmed in the described long-term clinical experience.

There are several reasons for the absence of keloid reaction in laser ablation: the absence of traumatic and ischemic action of the sutures and disruption of evolutionarily established regenerative mechanisms. Experiments with the cessation of limb regeneration in amphibians and reptiles when the amputation wound is sutured are known. Evolutionarily, humans do not have such regenerative abilities, because in our evolutionary line we did not often have to lose our limbs like newts. Our skin, however, has great regenerative potential. In fact, it is in the process of constant regeneration, constantly renewed and the usual injuries, such as abrasions, cuts, and burns do not leave noticeable marks. This evolutionarily optimized regenerative skin potential is under study and has served as a basis for a therapeutic approach in postoperative care for laser removal of skin lesions.

With laser ablation, there is never a complication such as "loosening" the suture, because there is simply no suture. The deep dermal layer remains intact, and the wound granulates and epithelializes below the waist to the level of the surrounding skin. This confirms the presence of an intimate, still insufficiently studied mechanism of cellular communication in the regenerative processes of the skin in free epithelialization.

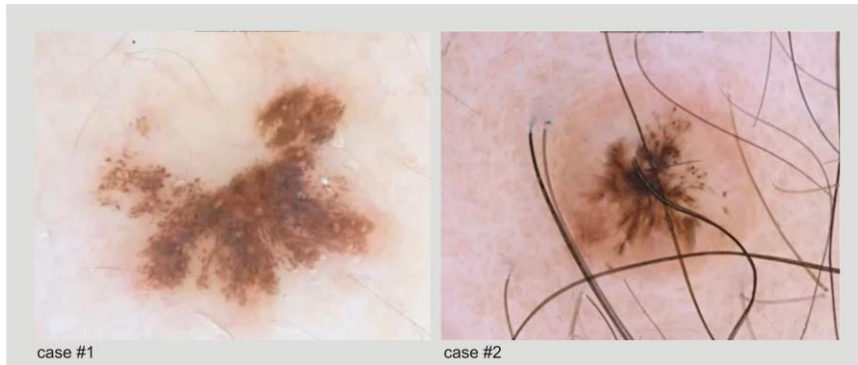
The approach applied during the epithelialization period is also important for the aesthetic regeneration of the wound surface. The practice showed at first glance something paradoxical - all products or dressings applied to care for the wound surface interfere with its normal and rapid epithelialization. The extended practice has shown that the most important component of this care is keeping the wound dry. This approach has become an integral part of the clinical protocol for necessary care after laser ablative manipulation.

The hypopigmented scar formed as a result of suture relaxation surgery creates a relatively wide field, unprotected melanosomal from the

mutagenic effects of UV rays. This unprotected scar may become a source of atypical cell neoplastic line in the future, which occurs in clinical practice.

Of course, surgery is the tool of choice for the removal of nevi with borderline activity and for lesions with the least suspicion of melanoma malignum, or for nevi with a violation of one of the risk criteria (ABCDE). The most optimal option is for surgical and laser methods to remove dermal nevi to be adequately and consensually combined. All pigmented lesions with the least macroscopic or dermatoscopic suspicion of deviation from the risk criteria or those identified as dysplastic are excised surgically and the material is examined histologically.

When removing a nevus with laser ablation, repigmentation can sometimes be observed in the area of ablation, which dermatoscopically and even histopathologically resembles melanoma. This picture is defined as Nevus recurrens or pseudomelanoma, which only mimics melanoma and is easily removed within the mandatory follow-up examination, but even left, this lesion does not evolve into melanoma. This linearly centrifugal repigmentation is due to proliferative activation of residual single melanocyte cells, usually left around a deep hair follicle, and occurs relatively early after laser or shaving surgically removed nevus (2 to 3 months). The most characteristic feature of a Nevus recurrens is that it always remains in the outline of the scar. The pathogenesis of this melanocyte proliferative activation is unclear, but it is not associated with malignant melanocyte dysplastic cell line. Recurrent nevus can be observed not infrequently after surgical removal of pigmented nevi, most often after shaving surgery. It should be noted that, in contrast to recurrent nevus, recurrent melanoma is manifested by pigmented hairs or macules outside the scar, which appear relatively late (8 - 26 months) after surgical excision of melanoma. Therefore, early and late follow-up examinations are extremely important in the removal of pigmented lesions in both surgical and laser interventions.

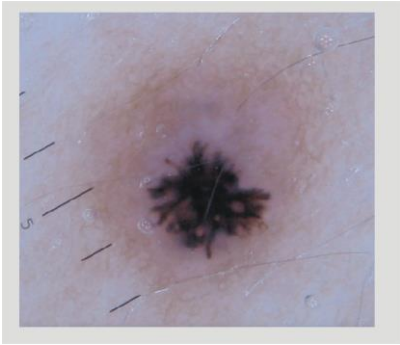


**A typical Nevus recurrens picture with the appearance of an exploding star in the area of a removed pigmented nevus with a classic surgical shaving technique.**

The intimate mechanism for tracking the activation of nevus melanocytes and their ways of radial migration after an apparently incompletely removed nevus has not yet been studied. This is due to future detailed research because it is apparently related to embryonic morphogenesis and cellular control that maintains ontogenetic tissue homeostasis. In a different way, at the end of embryonic morphogenesis, the organism accepts the wrong structures that have arisen, such as congenital nevi as complete organs, and applies to them the same control cellular mechanisms as to closely cellular specialized organs. This hypothesis, therefore, does not increase in proportion to ontogenetic growth and they have mechanisms for regeneration. The fact that the recurrence of the nevus does not leave the boundaries of the removed nevus confirms my hypothesis that melanocyte cells in the wrong tissue structure, such as the mole, are in a state of normal homeostasis control and not neoplastic uncontrolled growth. The picture of Sutton's nevus is different. Apparently, the immune system has found a genetic mismatch in the melanocytes of this nevus and seeks to eliminate it, destroying all surrounding supposedly normal melanocytes, forming a hypopigmented spot identical to that of vitiligo.

Existing occasional publications on the occurrence of melanoma after laser connection of dermal pigmented nevi with controversial ones cannot be compiled to prove such. Rather, it is an undiagnosed occult melanoma or recurrent nevus. In these cases, recurrent nevus is operated on radically as melanoma, and the mimicking histological picture prompted the histopathologist to reinsure and diagnose recurrent melanoma instead of

recurrent nevus. Strange why, these single published case reports feed skepticism only to laser ablation, but not to surgical techniques. In practice, recurrence of nevi is observed, it appears after a surgical error of nevi, in countries with traditions in the management of malignant melanoma. In these cases, repigmentation appears early and has never left the outline of the scar, even after years.



**Nevus recurrens after a shaving excision performed in the United States.**

The problem with making the correct diagnosis is that in cases of nevus on macroscopic criteria, history and evolution are more relevant than the analysis of the histopathological picture, considered to be leading in the choice of therapeutic behavior. This approach shows the magnitude of the percentage of misdiagnosed, non-melanomas and introduces an error in the statistics of the incidence of malignant melanoma.



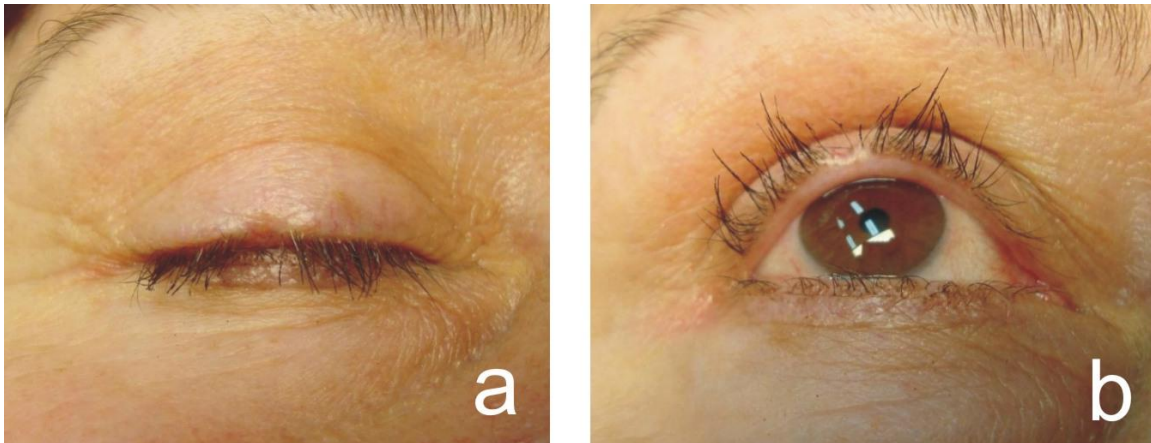
**Stages of removal of dermal congenital nevus and subsequent Naevus recurrens. The appearance of the first lesion (1). Three after the first month, ablation is observed in a radially increasing recurrent nevus remaining in the area of ablative laser exposure (2). Appearance immediately after ablation on the same date (3). Five months after the procedure, radially increasing pigmentation is included again, but with a much smaller size and non-leaving border of the first lesion, which is again ablated (4). The appearance of a controlled examination after five months (5). Follow-up examination 5 years after the last ablative session. The geometry of ala nasi is preserved without visible scarring, and no pigment changes are detected (6).**

## 4.2 Results and discussion of therapeutic techniques in anatomical zones of the head

### 4.2.1 Aesthetic laser removal of dermatoses on the eyelid, eyelid rim, and eyebrows

Very common on the skin of the eyelids and the blade edge, various lesions are located - papillomas, seborrhoeic keratoses, xanthelasma, which are a therapeutic problem for the dermatologist and it directs patients for surgical intervention in an ophthalmologist or a face and jaw surgery.

The eyelids are delicate anatomical structures and practice shows that even in many precision surgical approaches, a non-defective aesthetic result may result in a loss of symmetry, smoothing, losing eyelashes, ectropion, and visible non-fast cicatrization.



**View of an open and closed eyelid, after a troubleshooting intervention. Defect with loss of tissue, smoothing the blade, and losing eyelashes. This result can not be determined as aesthetic but as a substitution of a defect with another.**

Clinical experience has shown that the best aesthetic result in the removal of skin lesions in this area is achieved with dosage thermo-coagulation and ablative laser techniques. The approach allows skin therapy in these areas to remain within the reach of the dermatologist, but it must be very good to know the specifics of the anatomy of the eyelids and that the energy parameters of the laser effect should be refined in accordance with strict precautions. Inertia and blood supply, situated in the thin subcutaneous, should be known. The eyelid is made of a gentle fibrous

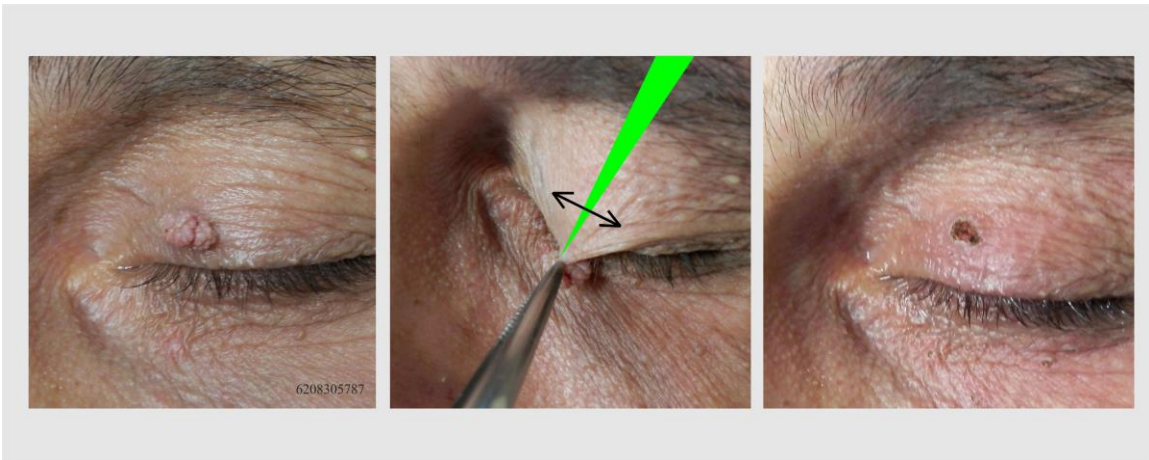
skeleton and reel connective tissue on which they are delicately integrated muscle groups responsible for the eyelid motorcycle. The skin of the eyelids is very thin and there is no fat pad. Immediately below it, *Musculus orbicularis oculi* has its eyelid and orbit part. On the eyelid edge, the gentle fibers of Riolan muscle are located. The skin of the eyelids is the thinnest in the human body and therefore, in energy impacts on it, these impact levels should be reduced and refined.

The specifics of the interaction of CO2 laser with tissues provide unique options for therapeutic impact on the eyelids, the blade, and eyebrows for many considerations. The most important specific is the self-limit of the thermoradiation processes on ablation that allows the impact to take place in a very thin layer without the risk of thermal load subject to assisted muscles, nerves, vessels, and glands. The functional specificity that the ocular cornea and conjunctiva are always covered with a slender liquid naturally protects it from diffuse reflections and dissipated radiation at 10600 nm. When working with low and medium laser capacities (3-5 W), accurate work ray and closed eye visual risks do not exist. Falling reflected diffuse rays on the cornea will cause slight warming of the laid film. This is not the case for lasers generating in the near-infrared or visible spectrum and working with them in the eyelid zone always needs to use metal-tailed shilts. The spectral lines of these lasers pass through eye structures and reflected or diffuse radiation even with low energy levels focus from the eye lens and can cause serious damage to the anatomical eye structures, especially the retina. When working in an infrared spectrum between 3000 and 10000 nm, the only vulnerable structure is the eyebrow. When working with CO2 and ER: YAG lasers there is no risk of damage to the eye from reflected and distracted rays because, as specified, the eyebrow is naturally protected by the lit liquid that covers it. Another physiological protective mechanism is the rapid mechanical prison of eyelids acting from minimal irritation. The ocular muscle is the fastest muscle and it closes the eye for less than 50-100 msec. If we assume that a surface of the tweezer or other tool reflects infrared light of a CO2 laser beam to the eye, this light will swallow 100% of the lit liquid. At low energy density, this will result in a slight warming of the lit liquid beyond a sensory threshold. For higher energy densities in the corner, a cross-reflex fastener, closing the eyelid will be reached. In these

energy levels, the cornea itself will not be damaged, but only slightly irritates. In my practice, I do not have any such incident, even though I have removed lesions on the migratory edge itself. Of course, in these cases, it is imperative to use the special metal jerk shrinks allowing comfort and tranquility when working in this delicate area.



**Eyelid metal shields for absolute protection of the cornea and suction cup for insertion and removal.**



**Another technique for safe work when removing eyelid lesions. The pedicular lesions are removed with tweezers outside the contours of the lash line so that the eyelid cannot be opened and the base of the lesion is excised high, with a focused beam. If necessary, the base is removed with the eyelid pressed by the operator.**

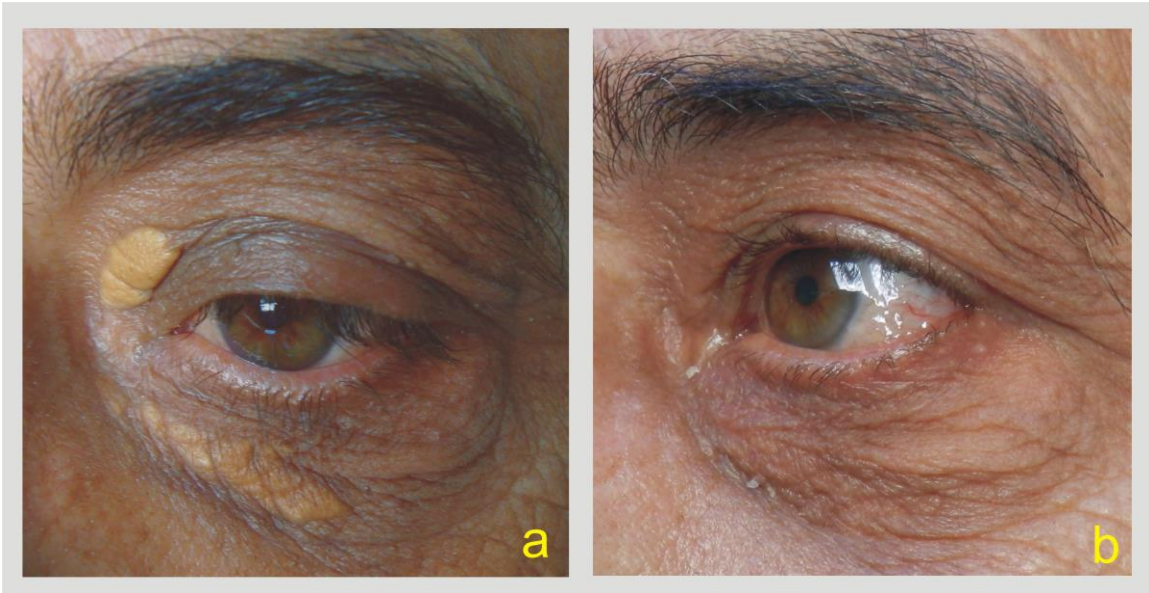


The CO<sub>2</sub> laser excision is the most appropriate for the removal of pediculous warts on the eyelids. The lesion is grasped with tweezers and pulled out of the eyelid slit with the eye closed. The skin of the eyelid has great elasticity and the lesion can be pulled out with tweezers outside the outline of the eye, after which it is excised high above the base with a focused laser beam.

All non-pediculous eyelid lesions that are at the level of the skin or slightly protruding are ablated or subjected to rapid coagulation thermolysis with a defocused beam, working with power densities of 100 to 400 W / cm<sup>2</sup> at medium power in superpulse mode not more than 4 W (focal spots from 0.8 to 1 mm). The laser exposure time is controlled only by the pedal and is assessed visually. Larger lesions are rapidly treated with ablative power density levels (LFDA technique) at a small focal spot or subjected to a single shot (OSA technique). The underlying dermal structures suffer relatively little energy load due to the small fast-moving focal spot, the high heat capacity of the tissue water, and the cooling of the numerous underlying blood vessels.

In the removal of xanthelasma, laser fast draw ablation (LFDA) of the epidermal layers is performed until the base of the cholesterol plaque reaches the loose connective tissue of the eyelid. The manipulation is performed with the underlying eyelid skin stretched to the maximum until ablation of the entire plaque

During this stretching, the eyelid is held in a closed state, which completely eliminates the ingress of laser light on the cornea.



**A 59-year-old patient with elevated LDL levels and pronounced xanthelasma as a clinical syndrome (a); and three years after laser plaque ablation (b).**



**Xanthelasma of the right upper eyelid in the same patient (a); view of the lesion after ablation at the maximally stretched underlying skin (b); final result three years after laser ablation (c). Initially, the hypopigmented scar a year later was normally pigmented, which is evidence of maximum tissue sparing in this method.**



**A 72-year-old patient with xanthelasma of the upper eyelids was removed ablatively in one session. Epithelialization is so good that scarring is not detected.**



**A 51-year-old patient with xanthelasma had her eyelids removed in three sessions without noticeable scarring.**

The ablated area has no contact with a surgical instrument and the formed thermocoagulation surface crust is a sterile airtight bandage, preventing impetigenization and guaranteeing the aesthetics of the end result. The manipulation is bloodless and is never accompanied by hemorrhage, which is not the case with surgery. In this approach, there are no surgical sutures, ischemic, the delicate dermal structures of the eyelids, and the scar formed is delicate and difficult to notice. There is no need to apply topical antibiotics, which to some extent slow down the epithelialization and can compromise the aesthetics of the end result. When

removing large cholesterol plaques after the epithelialization of the control examination, an effect of shrinkage and smoothing of the sagging eyelid skin (laser blepharoplasty) is observed. To enhance this aesthetic effect, it is good to spread the ablation elliptically to the left and right in the adjacent healthy skin around the cholesterol plaque, which enhances the effect of blepharoplasty and blurs the boundaries of the delicate scar. With laser thin-layer ablation of cholesterol plaque, there is no risk of obliteration of larger blood vessels, which could damage the complex collateral scheme of blood supply to the eyelids. In the classical surgical approach, this is not the case and a change in this circulatory pattern can lead to compensatory dilatation of some vessels and make them visible through the delicate epidermis in this area.

All patients with xanthelasma should be warned to monitor their blood cholesterol levels periodically (mainly LDL and triglycerides) and to consult a cardiologist and endocrinologist. Cholesterol plaque may be delayed by seasonal increases in LDL or idiopathic elevated levels in the past. My clinical experience shows that this dermatosis is much more common in patients with photodamaged skin. Mandatory control examinations are performed after the procedure. On these examinations, the small residual cholesterol gaps found are ablated in a timely manner. Cholesterol plaque grows like a crystal and accumulates around an already deposited or residual substrate, so these check-ups are especially important.

The placement of an eyelid metal shield ensures complete protection of the cornea if the lesion cannot be pulled out of the eye socket or work on the lash line is required. When working on or around the eyelids, they are pressed by the operator with the freehand, and the hand guiding the laser beam is used to firmly support the forehead or cheekbones, fixing the patient's head still. This support is mandatory for the precision of the manipulation, similar to the technique of precise drawing.



**A 61-year-old patient with an upper right eyelid fibroma. The lesion interferes with vision, provokes headaches, and creates aesthetic discomfort (a); view immediately after ablation (b); the final result (c). The lash line is not deformed, and there is no loss of lashes.**



**Benign verrucous formation of the lash line and two months after ablative removal. Convexity and eyelashes are preserved.**



**Dermal nevus removed by laser ablation in one session and late control review after seven years.**



**Dermatofibroma under the eyebrow, removed by laser ablation for aesthetic considerations and appearance on late check-up – a barely noticeable, and delicate scar.**



**A 41-year-old patient with a dermal nevus on her right eyebrow, which the patient was forced to cover up with make-up. Results one year after laser ablation. The scar is difficult to detect, and hair follicles and their inclination are preserved.**

Seborrheic keratoses are very often localized in the delicate area of the eyelids. This benign parakeratotic lesion strongly affects the epidermal layers and its surgical removal, in my opinion, is completely unjustified and wrong. Surgical manipulation in this area always carries risks of rough

scarring, ectropion, and distortion of the lash line. Rapid laser ablation, due to its self-limiting thermal irradiation nature, is not associated with such risks. On the other hand, in extensive lesions, the ablative procedure can be performed in stages in order to avoid impetigo risks, which could only compromise the aesthetics of the end result.



**Seborrheic keratosis on the left lower eyelid, and result two months post removal.**



**Seborrheic keratosis, before and after.**



**Seborrheic keratosis, before and after.**

### **Basal cell carcinoma (BCC) in the eyelid area**

In people with increased solar damage, the eyelids are often an area of basal cell carcinoma (BCC). Loose connective tissue in this area favors the rapid progression of the tumor. The clinical protocols established in world practice for the removal of BCC in this area are based only on a surgical approach. Patients who refuse surgery are left with no alternative to treatment. Their refusal was based on fear of surgery, provoked by the possibility of an extremely unaesthetic, disfiguring result. Surgical plastic surgery in this area does not always give a good cosmetic result.

On the other hand, possible residual microfoci covered with the surgical plastic technique may be encrypted in-depth, and recurrence after surgical plastics may be detected late. When removing basal cell carcinoma with laser ablation, the wound surface is left to open free epithelialization and recurrences are easily noticeable and remediable during the mandatory follow-up examination or during the five-year follow-up.





**A patient with a typical picture of basal cell carcinoma under the lower eyelid, removed in one session with laser ablation. View of the area a year and a half after the manipulation. Recurrent outbreaks are not detected. Epithelialization is at the level of the surrounding skin, without tissue loss despite the deep ablation. The scar is invisible, and any recurrence would be detected and eliminated in a timely and easy manner, yet the patient should be well informed, and aware of the need of follow-ups and a strict photoprotection.**

The treatment of basal cell carcinomas of the eyelids with laser ablation is not included in the accepted guidelines and only surgical intervention is recommended. Despite existing studies and published results for successful laser treatment of BCC, this approach is viewed with reservations and unreasonably skeptical because it is not known. These guide recommendations do not mention any alternative approach for patients who refuse surgery. Very often these patients in search of alternative solutions come across herbal and esoteric methods, which ultimately lead to the advancement of the tumor and a real danger of loss of aesthetics and even loss of vision. Existing other therapeutic modalities such as Imiquimod, 5-fluorouracil, Solasodin, and PDT (ALA) are only suitable for primary and superficial basal cell carcinomas and are not suitable in the eye area. The laser technique can be well combined with a combined approach, as after surgical excision any recurrent focus is ablated or when the primary large formation is gradually reduced and the residual lesion is excised in smaller

operative limits, where the risks of ectropion, entropion, and loss of aesthetics are minimized and without compromising the radicality of treatment.



**BCC in a clinical picture of Gorlin-Goltz syndrome successfully removed by ablation and followed-up for five years. To remove this lesion, the patient at first consulted plastic surgeons who refused to operate on this lesion due to fear of an unsightly outcome. The patient was informed about the possibility of gradual laser destruction of the lesions and aware of possible complications. All 15 trunk lesions were also treated with laser layered ablation. The patient was followed-up for a period of 5 years during which there were no recurrences, and was warned about the possibility of new lesions in the view of the Gorlin-Goltz syndrome course.**



**BCC in a 60-year-old patient involving much of the lower eyelid and eyelid view five years after laser ablative removal. She refused surgery after explaining the high probability of an unaesthetic result and ectropion, and even loss of vision. The lesion was subjected to gradual laser ablation in several sessions. The patient was observed for possible recurrences for a period of 5 years. No recurrences were observed during the follow-up period. The size of the lesion necessitated gradual ablation in order to better and aesthetically epithelialize, and avoid contracture leading to an ectropion. The end result is a delicate, barely noticeable scar.**

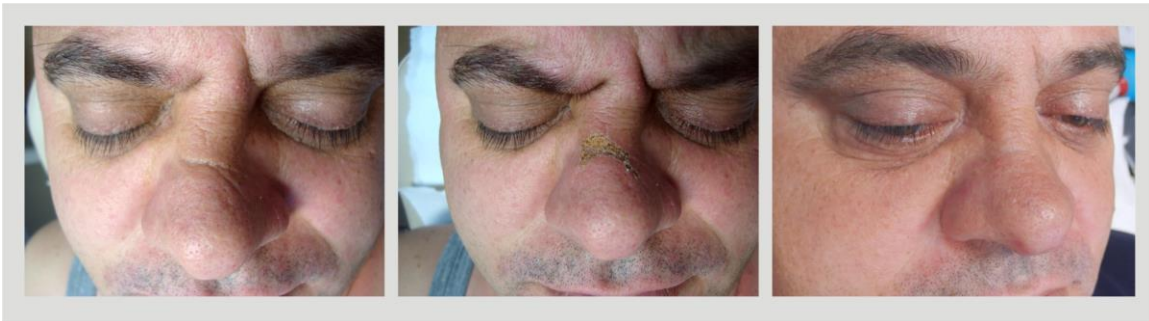
The therapeutic and aesthetic efficacy of the application of ablative CO2 techniques proves that they are particularly suitable for the treatment of benign lesions in the eyelids, eyelids, and eyebrows, as well as in non-advanced non-melanoma neoplasms. LFDA therapy provides a high aesthetic of the end result and a number of benefits proven in an extensive clinical trial:

- the hair follicles of the eyebrows and eyelashes are spared;
- the contour of the lash line is not broken;
- there is no risk of obliteration of larger blood vessels, damaging the complex collateral scheme of blood supply to the eyelids;
- Surgical instruments are not used where there is a risk of contamination with prion and viral particles;
- the treated field is self-sterilized and does not require antiseptics and postoperative medication;
- the operative time for lesion removal is extremely short - seconds;
- the manipulation is bloodless;
- the procedure is completely safe for the patient's vision;
- is performed in an outpatient setting;
- its cost is significantly lower than that of surgical procedures; no anesthesiologist, consumables, operating room and nurse are needed;
- multiple lesions on the upper, lower eyelid, eyebrows, and the whole face can be removed in one session;
- swelling and bruising are not observed, which are almost mandatory for surgical interventions in this area;
- no need to apply a bandage. The coagulation crust on the wound surface acts as a reliable bandage during the epithelialization period and can be easily covered with make-up powder;
- the postoperative period is without edema in most cases or if it is observed, it is transient - a day or two.

#### **4.2.2 Laser aesthetic removal of dermatoses in the area of the nose and near it**

The skin and subcutaneous tissue covering the nose differ anatomically from those of the face. There is no underlying fat layer and no muscle tissue. Numerous hypertrophied sebaceous glands are located in the reticular dermis and the thickened dermis is firmly fused with the underlying nasal cartilage structures. Surgical interventions to remove larger lesions on the nose do not allow the defect to be covered by removing the surgical edges. Therefore, translocation lamp techniques from an area adjacent to the nose are applied and resection lines are involved in a wide area. These

surgical plastics do not always give a good cosmetic result. On the other hand, the translocation flap always has a different skin structure than that of the nose, and this is always noticeable. Layered ablation is a good alternative for the successful removal of pathological-unaesthetic lesions on the nose with open epithelialization under the crust. The relatively thick dermis in this area allows deep ablation of areas that epithelialize without or with minimal scarring. This is due to the anatomical fact of the elongated channels of the hypertrophied sebaceous glands in this area. The epidermal cells covering these channels serve to initiate reepithelialization and rapidly restore the nasal epithelium without scarring. In the case of defects with tissue loss, laser fast draw ablation of the adjacent healthy skin is successfully performed until the level of the bottom of the existing defect is reached.



**Tissue loss after an accident when working with an angle grinder (a). View of the area after ablative laser sculpting of adjacent healthy areas to the level of the defect (b). Final result 2 months after the ablative procedure.**

Layered ablation can correct defects with tissue loss along the nasal contour, abutting adjacent healthy areas to the level of the indentation. Thus, the nose can be sculpted aesthetically. The same technique is used for rhinophyma, as large vegetations are laser excised before ablative sculpting. In stages, the contours of the nose can be sculpted to achieve proportionally acceptable dimensions and aesthetic shape.



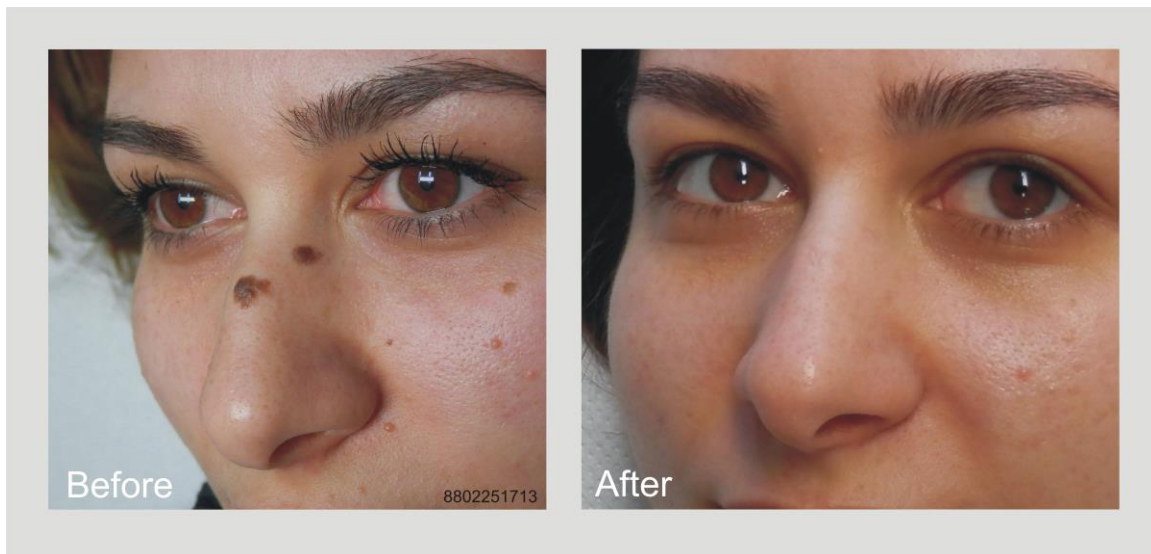
**A 16-year-old patient with rough scarring of the nose after an incident undergoing ablative sculpting.**



**Grotesquely deformed rhinophyma nose, corrected with laser excision and sculptural ablation.**



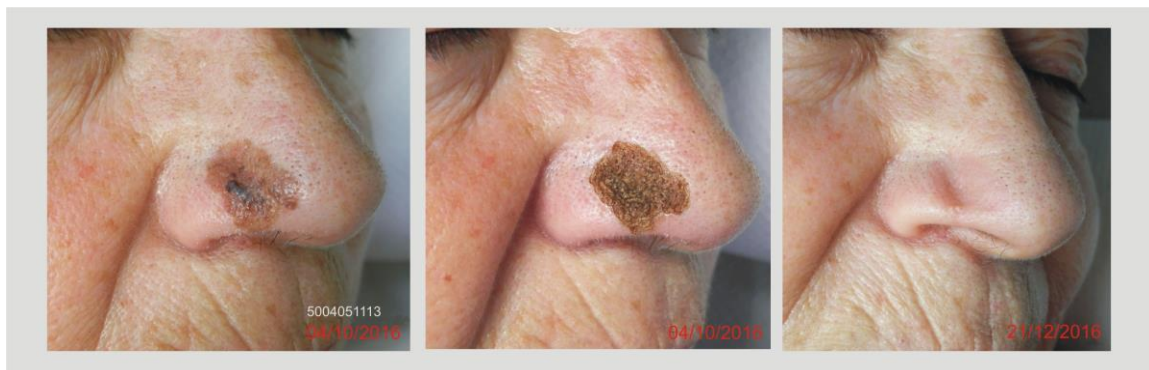
**Unsightly dermal nevi between the eyebrows and under the tip of the nose, before and after removal.**



**A patient with dermal congenital nevi, one with an impaired board criterion but no progression over time. Unsightly lesions create daily discomfort, carcinophobia, and an emphasis on concealment, however she still refuses surgical correction for fear of gross scarring. Results one-year post laser ablation. The places of ablation are invisible and the patient shares of an increased self-confidence and in interpersonal relationships.**



**Pediculous dermal nevus of the nasal wing growing slowly due to swollen fatty cysts in it; before and two months after laser therapy.**



**Solar lentigo in a 67-year-old patient was removed in one session and followed for five years.**

In very small lesions with disseminated multiple expression, it is appropriate to perform single-shot ablation (OSA), the lesions being ablated in a single shot. This allows the removal in a short time of a large number of small and medium-sized lesions without excessive thermal stress on the underlying tissues. Formations with a larger diameter  $> 0.5$  cm are ablated with a fast beam technique, layer by layer until healthy tissues are reached - fast laser ablation (LFDA). It aims to not thermally affect the deep dermis.





**An angiofibroma over the angular vein, in the range of the visual field and provoking headache. 4 years ago after laser therapy.**

#### **4.2.3 Laser aesthetic removal of dermatoses on the lips and the area around them**

All unaesthetic prominences can be successfully corrected with dosed layer-by-step and stepwise laser ablation. Photo documentation is mandatory to monitor and analyze the results of each lip correction procedure. Procedures are never performed in one step to avoid obstruction of the capillary network at depth, which would lead to discoloration or connective tissue contracture. After the ablative symmetry of the lips, it is good to apply a hyaluronic filler for modeling and aestheticizing the volume and contour. If there is tissue loss (dent), the hyaluronic filler is used as an expander in this area and can be repeated. Defects with excessively superficial hyaluronic filler or migration are also not uncommon, with unaesthetic papular prominence and Tyndal effect. In these cases, a narrow ablative canal with a diameter of approximately 0.2 millimeters is made at the site of prominence. Squeeze the filler with light pressure. This light manipulation avoids the long period of resorption or injection of hyaluronidase (Vitrace®), the application of which can lead to subcutaneous depression in a wider range. This manipulation is also suitable for all areas of the face or

those where the hyaluronic filler has migrated non aesthetically. The narrow ablative canal epithelializes within a few days and does not cause scarring.



**Grotesquely enlarged lips with a permanent silicone filler placed 15 years ago (a, b); a deformed contour after surgical removal of silicone filler (c, d); result after laser ablative correction (f). The defect with tissue loss of the left lower lip (d) was expanded with a hyaluronic filler. The smoothed lip contour of the surgery was corrected ablatively and highlighted with a hyaluronic filler. Facial skin is rejuvenated with deep and superficial fractional resurfacing. Final result 5 years after the correction of the lips and facial resurfacing (e, f).**

When removing lesions around the lips with classical surgical techniques, there is a risk of fibrosis with subsequent pulling of the tissues and violation of the oral symmetry at rest or during speech activity. With laser ablative removal of such lesions and free epithelialization under the crust, this risk is avoided.



**Nevocellular nevus, growing as an aesthetically positioned mole of beauty (tache de beauté). Surgical removal of this nevus carries the risk of pulling and breaking the symmetry of the lips. The growth of this nevus is due to swollen sebaceous glands in to the narrowed and elongated outlet channels of these glands. Results 2 months post removal with laser fast draw ablation - a delicate hypopigmented scar at the level of the surrounding skin, and without disturbing the symmetry of the lips.**



**Dermal nevus located on the "Cupid's bow". Surgical removal of this unaesthetic lesion is impossible without disturbing the contour of the upper lip. In this case, laser ablation is the tool of choice and this is confirmed by the end result.**



**Another large dermal nevus increased in size due to swollen comedo structures. The patient denied surgery due to the high risk of unaesthetic scarring. The nevus is excised and ablated at the base, left to free epithelialize under the crust. The scar is difficult to spot, and the area is normally pigmented by migrating melanocytes stored in the deep hair follicles.**

#### **4.2.4 Laser aesthetic removal of dermatoses located on the ear**

The auricle is an anatomical structure with complex geometry and is of particular importance for the harmony and aesthetics of the human face. The auricle is elastic cartilage covered with skin that is firmly attached to the perichondrium and surgical coverage of the defect with a skin suture is impossible. Any deformity and scarring after surgery and trauma are markedly noticeable here.



**The appearance of the auricle after classic surgery BCC resection. Definite, but not very aesthetic result.**

Laser ablation and excision are good new alternatives, which in most cases are a means of therapeutic choice in this area. Interestingly, the auricle epithelialization is so good that scarring after laser ablation even in a large field is invisible. This is due to the fact that the skin covering the underlying cartilage is very thin and lacks subcutaneous tissue and the shape is determined mainly by this cartilage. Therefore, in laser therapy in this area, the technique of "cold" thin-layered fast draw ablation (LFDA) is applied, aiming at maximum sparing of the perichondrium. Ablation should be fast - in one or two passes at a power density of 200 to 500 W / cm<sup>2</sup>. When excision is required, it is performed high above the base of the lesion, and the base is ablated to the desired level.



**Two unaesthetic dermal nevi of the right auricle antitragus (a), removed by laser excision and subsequent sculpting with laser CO<sub>2</sub> ablation (b). At the follow-up examination after 12 months, the scar was not detected (c) and the patient reported that this defect was the reason why she has not worn earrings and hairstyles with open ears so far.**



**A patient with seborrheic keratosis on a broad base at the tip of the ear helix. She was forced to cover herself with a haircut and not wear earrings. The lesion was subjected to laser ablation in one session. A year and a half later, a visible scar was not detected and the ear lobe was decorated with earrings.**

It is not uncommon for a keloid reaction to appear on the lobulus auriculæ after impetigo in an ear-piercing procedure. Removal of these, sometimes up to the size of walnut keloids, can be performed by laser or surgical excision. After the wound has healed, it should be observed and, at the slightest tendency for keloid recurrence, injected intralesionally with a topical corticosteroid with depot action (Kenalog). Several months after keloid removal, the scar can be aestheticized by laser ablation or fractional resurfacing to achieve an aesthetic result.

The auricle is the site of precancerous actinic keratoses, which can evolve into basal cell carcinomas (BCCs). When they are not too advanced they can be successfully removed with CO<sub>2</sub> laser ablation.

Before choosing BCC therapy, a risk assessment should always be made, taking into account:

- The degree of tumor progression. When the tumor involves tissues in-depth and its diameter is greater than 1 cm (for nodular BCC forms), surgery should be preferred. Surface BCCs, even those with larger diameters, are successfully treated with CO<sub>2</sub>-fast laser ablation.

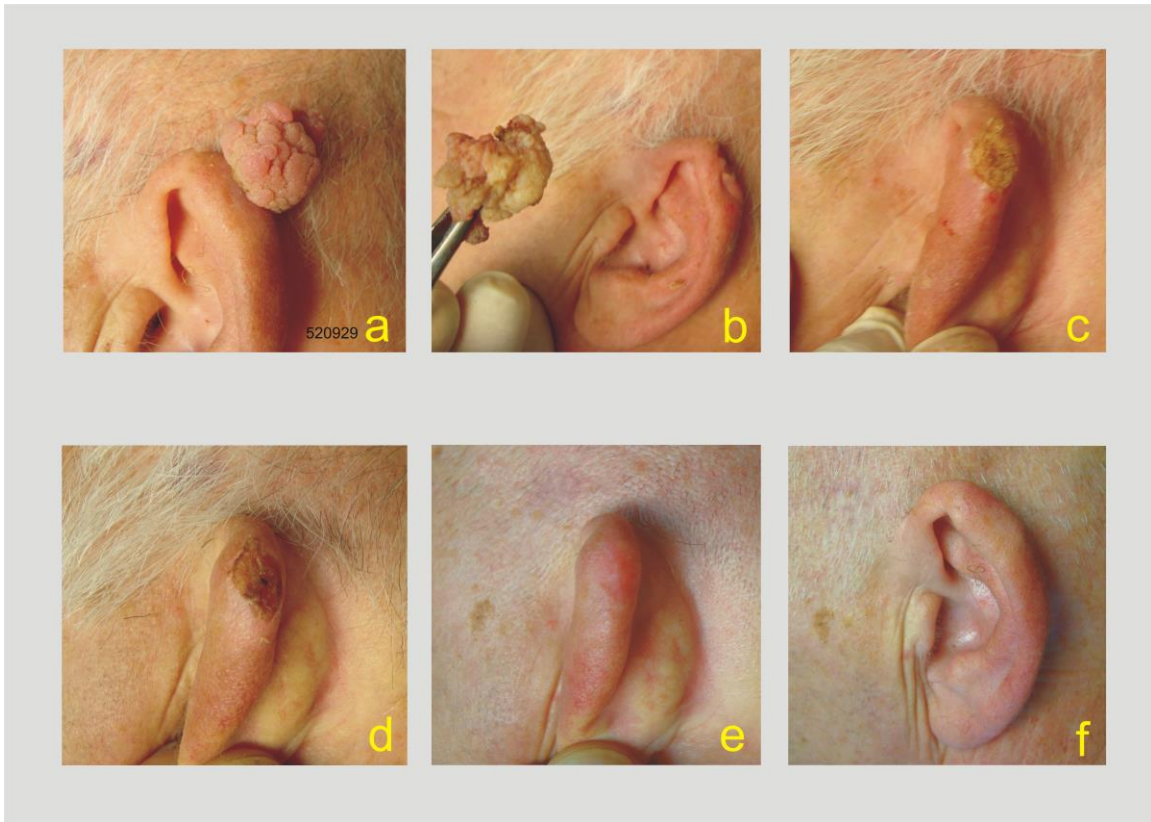
- In patients with multiple and emerging BCCs in Gorlin syndrome, laser ablation is a particularly appropriate outpatient method to remove all older and emerging lesions (Penev, 2020).

- Localization. When the tumor is localized in areas where it can progress perineurally or perivascularly, surgery must be preferred - in front of and under the eardrum, and neck. Also when the lesion is located above large arteries and nerve plexuses on the face. These are the areas above the angular vein and artery and the area below and in front of the ear where the facial nerve passes.

Basal cell carcinomas up to 10 mm in diameter can be radically and effectively removed in patients who have refused surgical resection and those with absolute contraindications for surgery. Patients are warned about the need for follow-up examinations for at least 5 years. In this therapeutic approach, in which the wound surface is left to free epithelialization (not sutured or covered with healthy skin), any recurrence that occurs is detected early by the patient or at follow-up examinations and is removed minimally invasively.

The CO2 laser is particularly suitable for the removal of unaesthetic benign and non-melanoma non-advanced neoplastic lesions in the auricle without the risk of gross scarring and deformity. Therapy with it provides a high aesthetics of the end result and a number of advantages proven in the extensive clinical experience described here, including:

- the perichondrium is spared, the contour and geometry of the auricle are preserved;
- surgical instruments that are at risk of contamination are not used;
- the treated field is self-sterilized and asepsis and dressing are not required;
- the operative time is extremely short (5-20 sec);
- the manipulation is bloodless;
- is performed in an outpatient setting;
- the cost is significantly lower than surgical procedures. Neither anesthesiologist, operating room and nurse, consumables, nor bandages are needed.



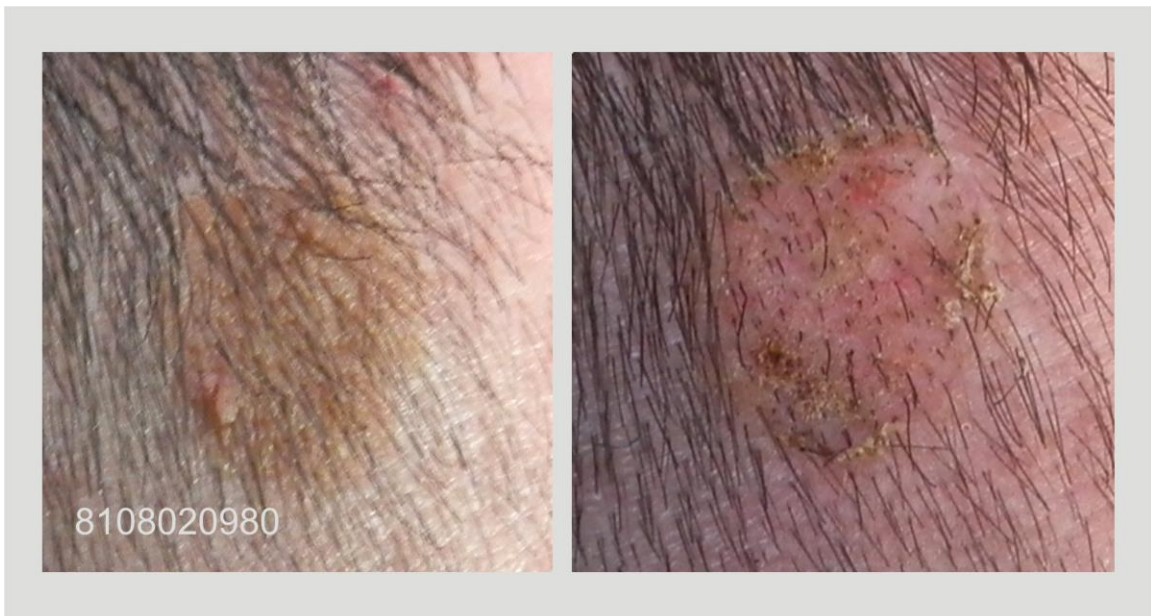
**Highly differentiated squamous cell papilloma of the ear helix (a); view of the laser-excised lesion in absolutely bloodless and non-contact conditions. The material is completely suitable for biopsy. The histological picture did not reveal cellular atypia (b); a view of the wound surface after laser ablation at the base of the lesion (c); view of the operative field on the seventh day after removal. The crust has not yet fallen off. Not even an inflammatory shaft (d) was detected; results two months after removal. The scar is delicate and inconspicuous (e, f).**

#### **4.2.5 Laser aesthetic removal of dermatoses on the kapilitsium**

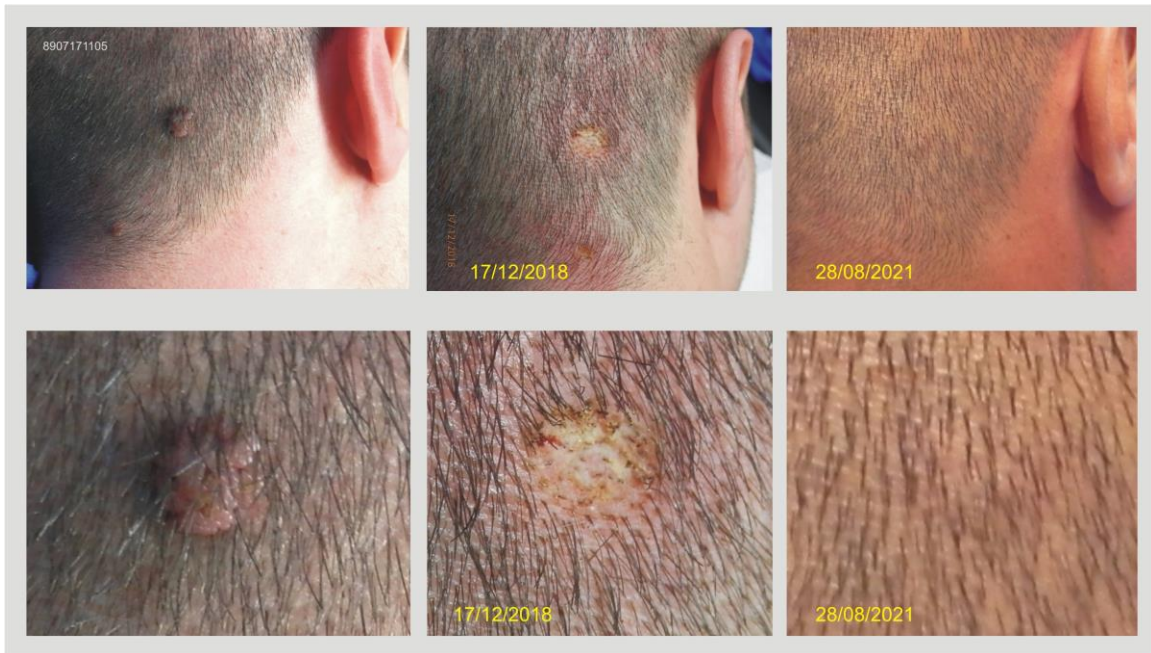
The removal of lesions in the hairy part of the head with the classic methods creates some aesthetic problems associated with hair loss. Some protruding and pedicular formations are a cause of discomfort when performing routine hygiene activities. CO<sub>2</sub> laser ablation and excision are suitable for the removal of benign epidermal and dermal lesions in the kapilitsium, given that hair follicles and their natural slope for the area can be preserved, and after epithelialization, the site of impact remains invisible. In a surgical approach, pulling the edges always disrupts the slope of the hair follicles, and some of them become clogged and inevitably become inflamed



afterwards. It is not uncommon for the seams to "relax" and form atrophic scars, which are clearly visible in people wearing short hairstyles. Large plaques of seborrheic keratoses, papillary nevi, fibroids, squamous cell papillomas, pyogenic granuloma, and actinic keratoses can be effectively removed by laser ablation. In lesions with a larger area, gradual removal with gradual reduction of the lesion size for faster epithelialization proved to be appropriate and the risk of subsequent impetiginization, which would compromise the aesthetics of the end result, was reduced. In this approach, the aesthetics of the end result are so good that scarring is difficult to detect despite the size of the lesion. When skin lesions in the kapilitsium area are removed with lasers in the visible and near-infrared spectrum, a noticeable scar with missing hair follicles is always formed.



**Seborrheic keratosis in the hairy part of the head is removed by thin-layer ablation. The hair follicles are preserved. With all other therapeutic approaches, there will always be a risk of hair follicle loss.**

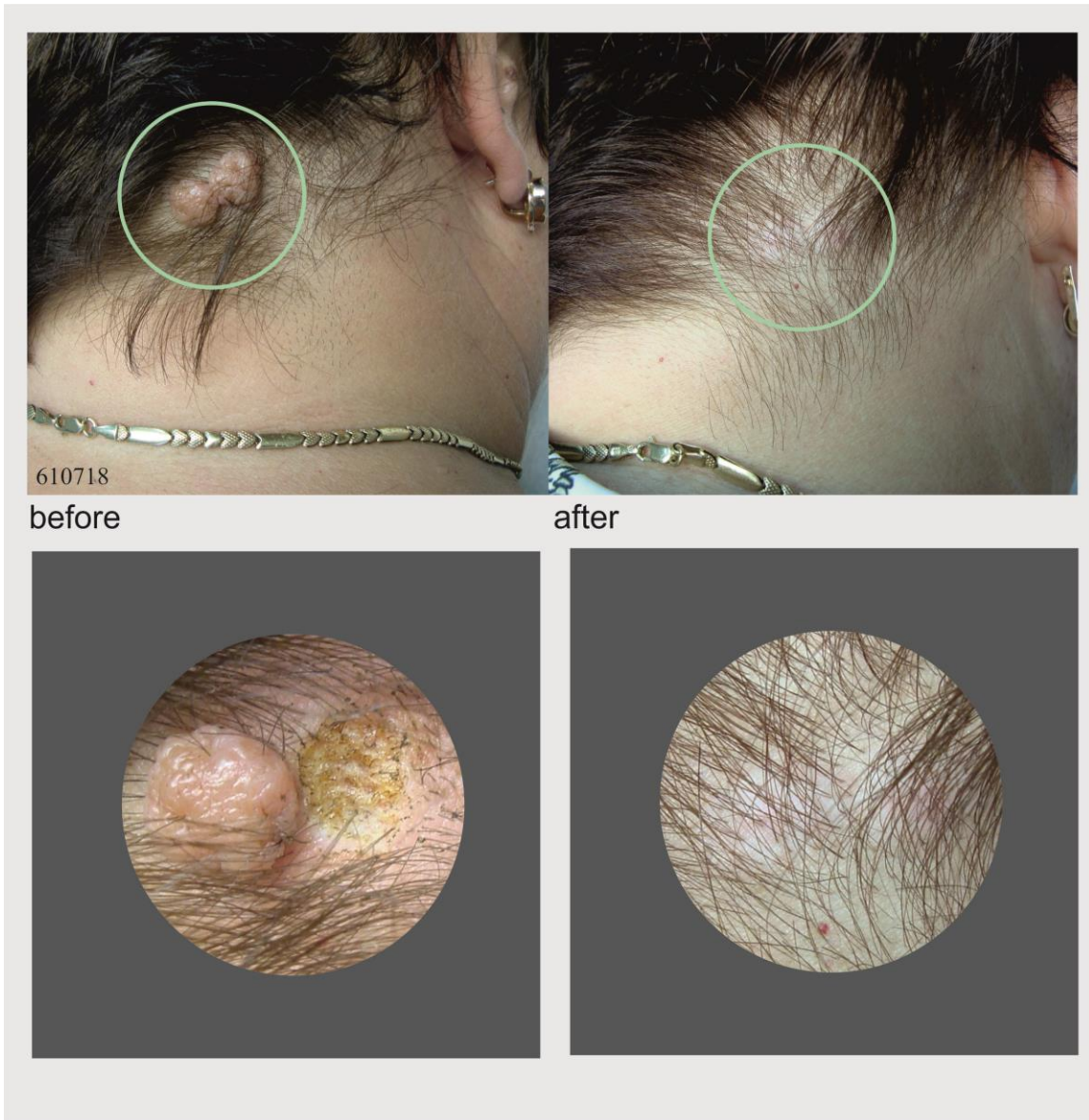


**A papillary nevus in the occipital region, creating discomfort when trimming. It was removed by laser excision followed by layered laser ablation. In the ablative bottom, it is seen that the hair follicles are preserved in-depth, which is confirmed by a follow-up examination three years after removal of the nevus.**





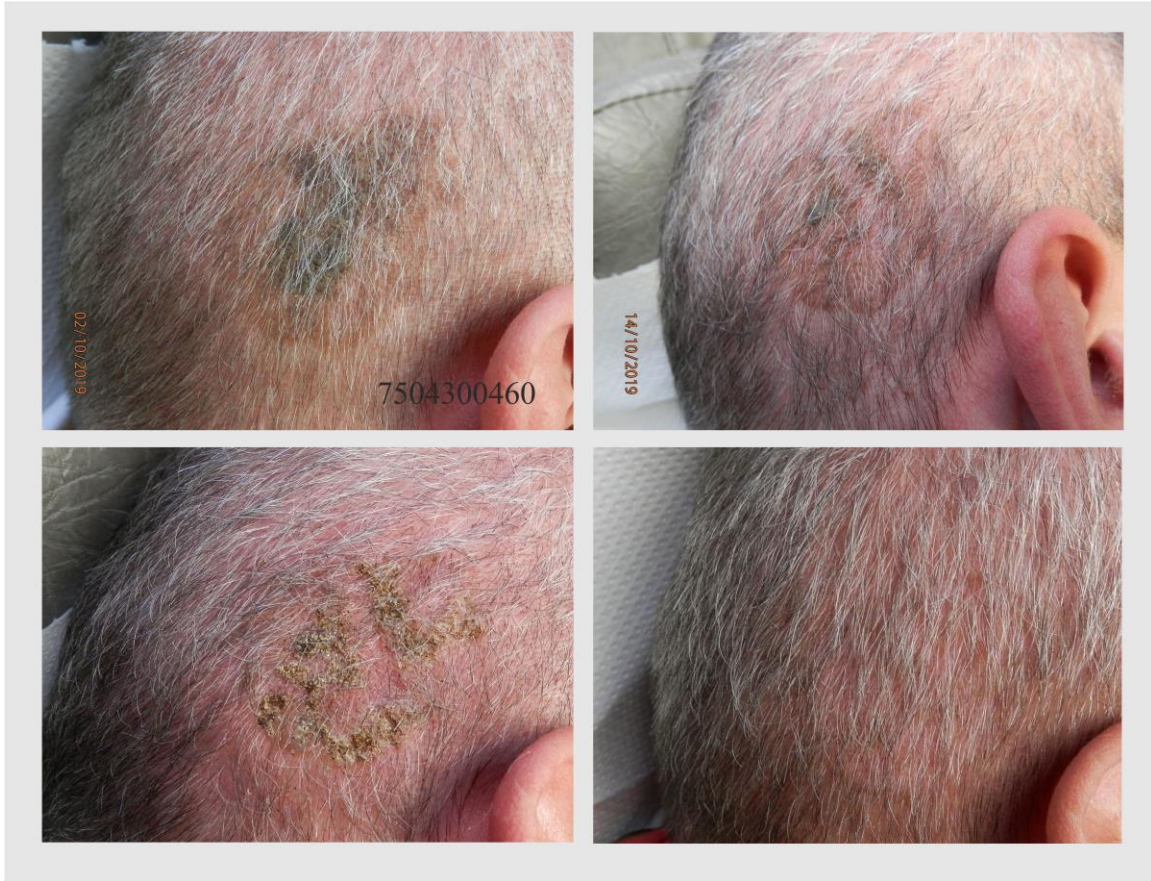
**Seborrheic keratosis, the surgical removal of which the patient refuses due to the risk of hair loss. The lesion was removed ablatively in 2 sessions. The control examination after the second session takes into account the complete preservation of the hair follicles and proves the exceptional aesthetics of the therapeutic approach.**



**Two dermal nevi in the occipital region of the kapilitsium removed sequentially. Delicate scars with preserved hair follicles were observed at the control examination.**



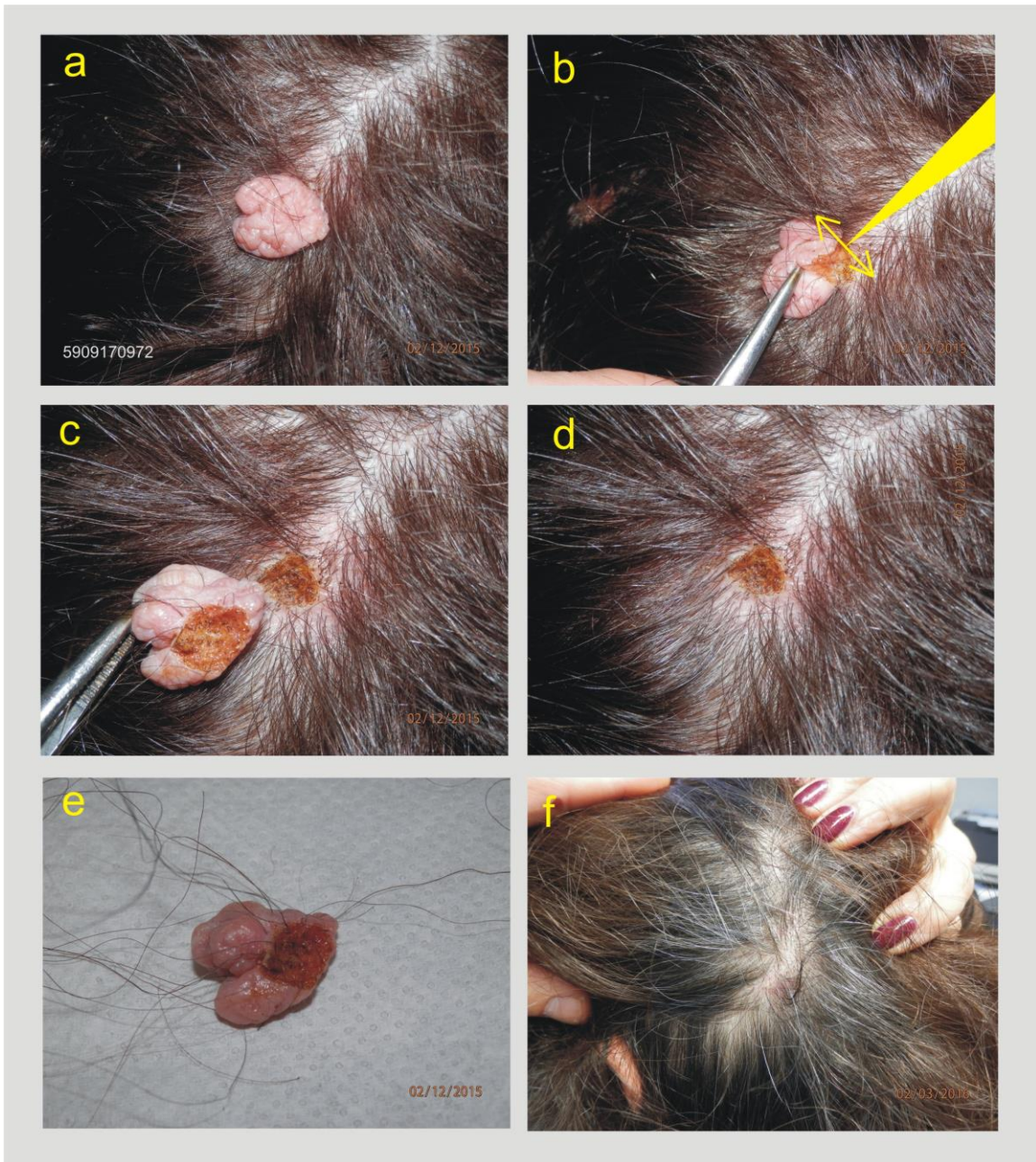
**Large seborrheic keratosis, which the patient conceals by constantly wearing a hat (a). The lesion was designated for surgical removal, which the patient refused after clarification of the required extensive reconstructive plastic surgery. The formation was removed by gradual laser ablation in three therapeutic sessions in order to avoid complications associated with the large diameter of the lesion (b), (d), (e). The regenerative epithelialization processes are so good that the site of the primary lesion cannot be detected (f).**



**Laser ablation of large seborrheic keratosis in the hairy part of the kapilitsium. Removed in two stages. Hair follicles and the direction of hair growth are preserved. Such a result cannot be achieved with surgical plastic surgery.**



**Large verrucous dermal nevus, causing discomfort during routine hygiene, before and appearance of the area two months after laser procedure to remove it.**



**Dermal nevus removed by laser excision.**

From the clinical material presented above and its discussion, it can be summarized that the indications and possible risks should be carefully analyzed before starting treatment. Care should be taken to remove lesions in areas where arterial and venous vessels and nerves are shallow and may be affected. These are the angular vein, the mental vein, and artery and the jugular vein, the branches of the facial nerve passing under the ear canal and

the temple. It is good when the vessels can be located visibly and the skin area to be treated can be pulled mechanically to the side. Caution should be exercised when treating patients with a tendency to keloids. Some topographic areas are considered "dangerous" for the appearance of keloids (lower jaw, neck area, shoulders, and upper arms). Patients should be explained the risks and limitations of therapy in order to gain a preliminary idea and not have unrealistic expectations before treatment. Part of good medical practice is signing of informed consent for the laser procedure and photo documentation before and after the treatment. Patients should be given a complete and detailed explanation of the care after their treatment in order to minimize the risk of complications.

#### **4.3 Results and discussion of a procedure for effective treatment of acne and erasure of its scars**

Much has been written about the etiology and pathogenesis of acne, but the problem unique to *Homo sapiens* has not been evolutionarily addressed. In the evolution of *Homo sapiens*, a rapid, genetically determined change in the pilosebaceous apparatus of the facial skin has occurred, associated with atrophy of the facial hair. This change began sometime in the late Miocene when the first hominids began to form genetically. The change was necessitated by the fact that the person has begun to transform into a social organ of communication and the non-verbal signals that he can send become possible only when facial expressions are clearly visible. The man became a hunter and the hunt was in a group. Fast and quiet facial expressions were needed in the group. The evolutionary process has changed the facial muscles, changed the skin and its appendages. The person deprived of hair has become emotionally expressive, and the sclera of the eyes is clearly visible and it very accurately indicates where the attention is directed.

With this relatively rapid evolutionary change, after reducing facial hair growth and atrophy, sebaceous gland drainage has become more difficult. With the increase in fat secretion for endocrine reasons, the problem with acne has also appeared. This problem was exacerbated by the disappearance of the usual seasonal animal estrus, and *Homo sapiens* began



to exist under year-round higher levels of androgens - responsible for libido and fat secretion, which emit pheromone signals. The increase in androgen levels starts at puberty. Then, physiologically and evolutionarily unoptimized processes with facial skin, manifesting as juvenile acne, are triggered. In other words, there is an imbalance in year-round, androgen-dependent increased fat secretion, the evacuation of which is hampered by rudimentary and slow-growing facial hair.

The rudimentary facial hair with prolonged anagen and telogen phases cannot reliably drain the hair follicle. In inflammation, and exfoliating friction, when the draining hair is in the initial anagen phase (shortly after the loss of old hair), the outlet of the already narrower hair canal may obliterate epithelialization. The sebum flowing into the hairy vagina remains closed and turns into a small slow-growing cyst in which anaerobic conditions are ideal for the development of the otherwise saprophytic *Propionibacterium acnes*. This is followed by a process of inflammation and pustule formation. Other microbiotic and xenobiotic actors are added to the inflammation, mainly *Staphylococcus aureus* and *Staphylococcus epidermidis*, which are also part of the skin microbiome. *Demodex brevis* and *Demodex folliculorum* inhabiting the hair follicle can also provoke and complicate the acne inflammatory picture. When the balance of the skin microbiome is disturbed by exposure factors such as detergents, antibiotics, corticosteroids, and retinoids, antibiotic-resistant, aggressive bacterial strains, also known as nosocomial infections, mainly aureus strains, are added to the inflammatory process. They aggravate inflammation and slow recovery. Acne worsens and becomes resistant to medication. The problem escalates with the inclusion of mental factors that make those affected look for all sorts of ways to remove these threatening and affecting self-image pimples. Acne has an adverse effect on facial aesthetics and this has a negative effect on self-esteem and hence worsens the quality of life of those affected.

Various therapeutic methods are used, but there is still no effective, rapid, and definitive treatment. Many factors are discussed in the pathogenesis of acne - endocrine, physical, chemical, biological, and hygienic. The pathogenesis of acne is supported by physical influences such as ultraviolet radiation, but also by anthropogenic factors such as hyper

hygienic, auto-aggressive, cosmetic actions, psychosomatics, stress, and dietary imbalance, inappropriate therapy, and more. Everything is arranged and forms an aggravated exposure background, deteriorating the skin. The ineffectiveness of therapeutic approaches further reinforces the psychological dominance, leading to an accentuation of attention when performing a series of hygienic and cosmetic rituals, which generally worsen the symptoms of the skin and normal psycho-social functioning. In this context, acne should also be considered psycho dermatosis. Actual can be defined as socially significant labor, deviating intellectually and potential, affecting the time and attention of the immediate environment of risks. In severe cases, acne can lead to depressive disorders and even suicide. In these cases, it is justified to use Isotretinoin in combination with psychotherapy. The retinoid is effective, affected by an increased reduction in any fatty secretion, but the effectiveness and contraindications must be analyzed on all sides and carefully to weigh the benefits and harms of them individually. Very often, after stopping them, acne resumes because the problem with clogged fat follicles remains. Apply so far light and laser techniques also have no logical basis for therapeutic efficacy. Therapy cannot be removed. These current clogged fat follicles and published results affecting the process are soon the results of a cycle of exacerbation or natural attenuation. For an effective treatment for the prolongation of juvenile and adult acne, the real reasons for detecting obstructed sebaceous glands must be emphasized. Treatment cannot be successful if the cause of the pathology is not found and eliminated.

For 30 years of clinical practice, a therapeutic methodology has been developed and improved for effective and lasting treatment of acne, and one for erasing acne scars with fractionated ablative laser effects. The positive results of the developed methodology applied in resistant long-term acne adultorum showed that the problem with this form of acne can be finally solved. In the latter, it was decided to apply this method to prolonged juvenile acne in its papulopustular form and after the exhaustion of therapeutic modalities. A clinical protocol was developed to optimize the effectiveness of the procedure.

Patients suffering from acne often feel desperate. They are also skeptical about the ineffectiveness of the therapy they have used. This forced

the developed methodology for laser therapy of acne to be started initially unilaterally (by analogy with the author's methodology for the treatment of multiple lesions on the head and trunk). This unilateral therapeutic approach allows the patient to compare and evaluate the differences between the treated and untreated areas of the face. Getting results allow placement and treatment for long-term therapy. Part of the therapeutic approach is the psychological work with the patient, which begins with a brief history and a request to describe in detail at home the history of his acne problem and everything he will try to treat it: actions, therapies, diets, and cosmetics. Reading this "patient essay" can reveal causes that show worsening acne, such as the fact that the sun and sunbathing and solarium "help" as well as drinking brewer's yeast, chemical peels, fear of germs and pollution, erasure on the skin with soda, sugar, coffee, etc. Acne is a popular breed of practice, which is due only to the hormonal imbalance of gynecologists, and almost always according to them the polycystic ovaries, although it is such an etiological cause, although very rare, really. The latter is related to the determination of contraceptives, but the effectiveness of this therapy is to the extent that lowering the level of androgens reduces the exogenous sebum secretion of the skin. This therapy makes sense when it comes to polycystic ovary syndrome when you increase insulin levels, but this pathology is much less common than acne. An experienced dermatologist can detect the signs of an elevated androgen level and without laboratory tests - excessive hair on androgen-dependent areas - face, abdomen, and back.

Focusing the affected person's consciousness on the appearance of the face only aggravates the problem. He is constantly washing, watching, touching, trying to squeeze the pimples. During this compression, the contents of the swollen sebaceous gland cannot be easily evacuated and the injured area inevitably becomes inflamed. After the pustule subsides, the injured area acquires a reddish tinge due to post-inflammatory vascularization, which persists for several months and is superimposed on the general background of swollen comedones, cysts, and inflamed pustules. A picture of exacerbated juvenile acne develops, which is further exacerbated by hormonally increased sebum. By prolonging the acne picture due to multiple inflammatory loci, some of the outlets and healthy sebaceous glands obliterate and turn into new small cysts (white dots) from which the

body can get rid only of physiological inflammatory suppuration, supported by the saprophytic anaerobic bacterium. *acnes*. When such a cyst is filled with a large amount of sebum pus and the process is transferred to neighboring follicles, the inflammation can cover the deeper dermal layers, and then, after the process subsides, the site scarring with tissue loss. The devastation of facial skin after severe and prolonged acne can range from minor to grotesque.

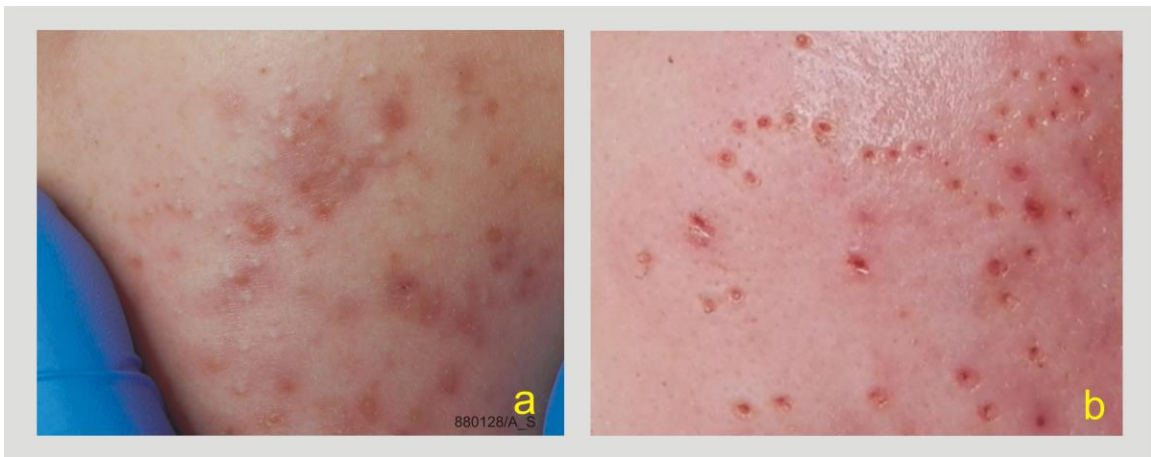
The author's own approach and methodology for effective treatment with the help of laser papulopustular (cystic acne) were developed. When acne is of the primary juvenile comedone type, classical therapies with comedolytic, topical retinoids and antibiotics usually control the process. The appearance of more clogged sebaceous glands is due to prolonged or improperly treated comedones juvenile acne. Other etiological reasons for the transition from comedones to cystic papulopustular acne are mechanical and chemical exfoliating procedures - peels, self-aggressive rituals with constant squeezing. Hyper solar exposure has been shown to worsen the picture due to the thickening of the skin and increased skin sebum secretion. The skin tan hides the redness of previous pimples and misleads that the sun "cures" pimples, but necessarily after a summer solar exposure acne worsens. With the appearance of obliterated sebaceous glands that have turned into cysts, the treatment of juvenile comedone acne according to standard therapeutic regimens becomes ineffective. It is the presence of cysts that can explain therapeutic resistance in many cases and explain why it returns after retinol treatment a year or two after acne is controlled. The author's approach described here attempts to revise the pathogenesis of acne by focusing on the etiology of closed fat cysts as a major etiological factor for resistant and prolonged ongoing acne. In the analysis of the process it became clear that with drug therapeutic regimens the existing fatty cysts cannot be removed and if there is a positive effect at all, it is not from the therapy, but rather due to the natural disappearance of the process. The process may not go away if the causes of cysts are not found and then there is a picture of long-term adult acne, resistant to all therapies. The wrong therapeutic approach in many cases is that only endocrine and inflammatory causes are sought. Deterioration, chronicity, and resistance to therapies can significantly damage a dermatologist's credibility. The problem with the

treatment of cystic acne is due to the fact that the cause of clogged sebaceous glands is not discussed or clarified. The ineffectiveness of existing therapies is evidenced by the availability of countless acne treatment products on the market, and the need for long-term "treatment" is becoming part of manufacturers' marketing strategies. All available products work on unilaterally considered etiological causes by means of antibiotics for inflammation, exfoliating and comedolitic agents in the presence of comedones, hormonal to reduce fat secretion, and epithelial to restore damaged skin. Clogged sebaceous glands cannot be eliminated with any of these therapeutic approaches. In this sense, all these therapies are meaningless and even become part of the problem. The pathogenesis of acne is not fully understood and the etiology and cause of obstructed sebaceous glands are neglected. Therapeutic approaches used so far can reduce and alleviate clinical symptoms, but do not definitively solve the problem in the long run. The therapeutic approach described here is based on the etiological hypothesis that the reason for persistent acne that has already gone beyond puberty and acne adultorum is precisely the presence of obliterated sebaceous glands turned into cysts (white dots), which inevitably at some point inflame and form the picture of papulopustular acne. The picture is exacerbated by the intervention of anthropogenic and psychogenic factors - squeezing, hyper hygiene, and ineffective therapies. The cause of fatty cysts should be determined by anamnestic data, patient essay, or deductive. The psychological approach in the search for these causes and their elimination is an important element of effective therapy.

The essence of the developed and applied methodology aims to reduce the number of still non-inflamed cysts (white dots) in the phase of papulopustular (cystic acne). The method is suitable for exhaustion of therapeutic drug efficacy in prolonged juvenile acne and is especially suitable for long-term acne adultorum.

Therapy begins with stretching the affected area of the skin. During this sprain, the cysts are well visualized and even those that do not normally pass and have the appearance of whitish papules are observed. Deep ablative laser perforations with a diameter of 150 to 200 $\mu$ m with the energy of 150-400mJ in a single pulse are applied in the center of several of these cysts. The laser beam is maximally focused so that it quickly ablates the epidermis

and penetrates deep into the swollen sebaceous cyst. When the laser beam penetrates deep, it heats the surrounding sebum. Some of the sebum liquefies and can be observed to flow through the ablative canal. With the help of a loop comedone extractor, the remaining contents of the fat cyst are easily evacuated with a light-dosed pressure that does not injure the surrounding skin. The manipulation is repeated on adjacent cysts - three to ten in number until drainage and evacuation of all available cysts in a selected half of the face. Ablative perforation of the cyst and release of sebum disrupts the anaerobic conditions for the development of *Propionibacterium acnes* and the treated areas usually do not become inflamed and epithelialize for several days. Inflamed pustules are also drained by an ablative canal, whereby the thermal radiation temperature sterilizes the purulent contents. In the applied therapeutic approach, no inflammatory deterioration after the perforation procedure was observed.



**A typical example of acne-prone skin (a). When the area is stretched, the blocked cysts ("white dots") are visualized and after applying ablative laser channels in their center, they are easily evacuated. The appearance of the skin area after the evacuation of the contents of the cysts using a comedo extractor loop (c).**



**Acne adulatorum in a 39-year-old patient with a known pathological component in its etiology. Several sessions were conducted to repair the blocked cysts and psychological work with the patient.**



**A 26-year-old patient with treatment-resistant cystic acne adultorum persisting from puberty. The patient has unsuccessfully applied all (according to her) possible therapies. Skin appearance before therapy (a) and immediately after removal of fatty cysts in the left half of the face (b) and (c) - the effect of therapy 6 months later.**





**A 27-year-old patient with acne adultorum with conglobate and nodulocystic characteristics is resistant to all sorts of therapies including Isotretinoin (a). The severe acne picture is ten years old. The patient underwent therapeutic laser sessions according to the procedure described herein. Four months after the procedures, no active acne foci were detected, only residual signs of severe perennial acne (e, f). After a few months, it is desirable to conduct zonal laser resurfacing procedures for aesthetic erasure of acne lesions.**

The appearance of the skin immediately after ablative laser manipulation can shock the patient because of the picture of many reddish holes in the skin, the size of which is due not so much to the laser channel as to the size of the evacuated cysts. Therefore, immediately after ablation, the treated area is covered with powdered antiseptic and antibiotic, after which a simple make-up powder in the skin tone is applied. Zinc oxide, talc, and humus - the main ingredients in the decorative powder keep the treated area dry, which prevents the impetigo of laser-sterilized ablative perforation channels and acceptably conceals perforations. The use of antiseptics and antibiotics is discontinued after the next therapeutic sessions because they to some extent slow down the epithelialization recovery processes and have a negative impact on the skin microbiome.

In the first therapeutic session, only one-half of the face is treated (unilaterally). This is important from a psychological point of view because the effect of the treatment calms the patient and satisfactory results stimulate him to continue therapy. It is mandatory to make photo documentation before and immediately after each procedure. The patient was instructed not to wet the area for two days to avoid secondary impetiginization when softening the sterile crusts formed on the ablative canal. These dotted crusts fall off on their own within a few days. The patient is informed not to remove them forcibly, so as not to disrupt the natural epithelialization processes. The patient's biggest concern after the first therapy is whether holes will remain visible at the sites of laser exposure. Long-term clinical practice shows that such residual indentations, although visible at the beginning, are completely erased in the following weeks and never leave noticeable scars. In the second therapeutic session, the same half of the face is treated again and it is explained that the other will be treated only when the patient wishes and determines the effectiveness of the therapy. Patients usually report therapeutic efficacy after the first procedure and wish to continue it in the other half of the face. It is best to treat the whole face in the third session. The therapeutic results are again photo-documented and compared with the initial image and the contra lateral half. Depending on the degree of exacerbation, an oral antibiotic (erythromycin, azithromycin, doxycycline) may be prescribed after the first and second manipulations. The number of clogged sebaceous glands that will potentially evolve into

acne pustules is finite, and if the expository or pathomimic causes that cause them are detected and removed, the process of exacerbated papulopustular acne is controlled quickly and without medication.

Psychological work with the patient is also carried out during the therapy, because prolonged acne, as mentioned, should be considered psychodermatosis. Many patients say that they cannot get rid of the ritual of squeezing, which has become a ritual, described as a feeling of increasing tension, relief from which occurs after performing this ritual. In these cases, it is useful and necessary to consult a mental health professional to overcome this obsessive ritual, which is one of the main reasons for the formation of fatty cysts.

After initiating laser therapy, the patient is required to discontinue the use of all currently used products and even detergents in order to:

- to determine the real efficiency of the laser procedure;
- to "learn" the skin to deal with the problem on its own;
- to restore the normal lipid layer of the skin by breaking the feedback, in which degreasing from shampoos and soaps initiates an increase in sebum secretion;
- to restore microbiome balance;
- to stabilize and normalize the skin acidity altered by the alkaline reaction of soaps.

After controlling the exacerbated acne, maintenance therapeutic sessions are needed to remove single cysts (every 1-2 months). The procedures are not interrupted during the summer period, because then the sebaceous secretion is increased and more clogged sebaceous glands are activated and visualized. Patients are warned about the need for photo protection, carried out mainly by avoiding staying outdoors, between 9 am and 5 pm. The patient is explicitly instructed not to rely unreservedly on a product with a high SPF because such protection is not absolute. Deceived that it is absolutely protective, it can be uncontrollably exposed to high doses of UVA light, despite the constant application of the product. Some of the ingredients in sunscreens often irritate the skin. At the end of the summer season, maintenance procedures are desirable more often. After the disappearance of acne, during the winter it is desirable to proceed to deep laser resurfacing procedures to smooth the skin from mild to moderate acne.

In severe lesions and in prolonged acne with deep scars, laser resurfacing is performed with high energy doses of 120 -200 mJ in the ablative canal and is repeated until an aesthetic result is achieved.

The fractionated procedures are performed according to the developed clinical orange for deep laser resurfacing. Deep scars with pronounced tissue loss are corrected with the help of a hyaluronic filler in order to expand the skin defect with tissue loss. During this expansion, the formation of a dark spot due to the Tyndale effect of the filler placed under the atrophic epidermis can be observed. The next step is to easily correct this with laser perforation and light pressure evacuation. Effective acne treatment is the first step to aestheticizing the face. The second stage is the erasure of severe acne lesions with scarring with varying degrees of tissue loss. This can be done after mastering the acne picture by conducting deep laser resurfacing sessions during the winter. The difficult drug response in many cases of acne proves that the endocrine and inflammatory components are not really leading in the pathogenesis of acne adultorum.

The results of the developed author's methodology, applied to long-term adult acne with CO<sub>2</sub> laser, show that the problem can be definitively solved without medication. The method is also suitable for the exhaustion of therapeutic drug efficacy in juvenile acne, which threatens to become chronic and lead to severe scarring and impaired skin relief. Effective treatment of acne requires psychological work with patients with an obsessive-compulsive disorder associated with hyper hygienic, pathological actions. In case of shallow but noticeable scarring and scars, it is recommended to conduct several zonal therapeutic sessions of deep fractional laser resurfacing (120-150 mJ in a micro ablative canal). In severe lesions after conglobate prolonged acne, resurfacing with higher energy levels above 160mJ in a micro ablative canal and several sessions in areas of deeper and more visible scars should be resorted to.



**Prolonged acne adultorum, pathologically provoked. Laser therapy was performed according to the methodology and psychological work with the patient to overcome the accentuation.**



**A 32-year-old patient with active acne adultorum on the background of total solar damaged skin (a). After removal of the cysts according to the described method (a1), the deep resurfacing procedure was performed to smooth the skin relief (b). The residual pattern of the high-energy deep laser resurfacing (b1) can be seen in magnification. This pattern faded over the next few months. The deep ablative resurfacing procedure can be repeated again with lower parameters.**



**Exacerbated and prolonged juvenile acne, unresponsive to therapy. In this form, acne would inevitably lead to severe scarring. The process is mastered in several laser sessions.**



**Another example of the positive effects of prolonged juvenile acne.**



**A patient with initial acne adultorum manifests with multiple cysts on the cheeks and temples (a) and (c). Effect of therapy after a series of procedures (b) and (d). Scarring of the cheeks can be smoothed out with a resurfacing procedure.**



**A 32-year-old patient with prolonged acne adultorum was unsuccessfully treated with all therapeutic approaches. She underwent the described method and after mastering the acne laser resurfacing was performed to smooth and rejuvenate the skin texture.**



**A 19-year-old patient with prolonged juvenile acne. The acne is resistant to numerous therapies. The patient underwent a series of laser procedures according to the described method.**





**Picture of prolonged acne of conglobate character, undergoing an intensive course of laser therapy to prevent future rough scarring.**



**Prolonged acne adultorum in a 30-year-old treated in several sessions. Supportive senses are needed during the summer months to remove residual papules before they have evolved into pustules. During this period, the residual erythema will disappear and, if necessary, a procedure for deep laser resurfacing will be performed during the winter**

#### **4.4 Results and discussion of ablative laser resurfacing procedure**

Ablative laser resurfacing is a therapeutic technique for rejuvenating facial skin, which can actually improve skin texture and elasticity, erase fine and deep wrinkles, correct acne scars, stretch marks, and rough scars caused by trauma, burns, surgery. Ablative laser resurfacing allows to improve skin turgor and rejuvenates facial skin. There is no risk of grotesque changes in facial expression, which can sometimes be observed after surgical facelift or blepharoplasty. The procedure is performed according to an optimized author's clinical protocol, the result of many years of clinical experience, and to increase the efficiency, our own biophysical model was developed. The procedure is registered as an author's trademark - FasetLift™

With this laser procedure, the visible signs of aging skin can be effectively and permanently affected - elastosis, wrinkles, melasma. There is a lot of data in the scientific literature on the effectiveness of ablative laser resurfacing, but nowhere are real therapeutic techniques and operating parameters discussed. The claim that the lifting effect of this procedure is due to the stimulation and construction of new collagen is multiplied, but this explanation is quite superficial, not revealing the biophysical mechanism of the process. The observed phenomenon of instantaneous contraction of the treated area during the procedure itself and why the effect of it is lasting is not explained. The intimate mechanisms of influence have not been sufficiently studied. A reasonable physical model clarifying the processes has not been created to optimize the parameters of the procedure. In the process of accumulating empirical observations and clinical experience, a new concept was built for the biophysical mechanisms arising from deep laser resurfacing and that the lifting effect is due not so much to the subsequently synthesized new collagen as to the effect of permanent coagulation retraction of connective tissue fibers. near the ablative canal. When the laser beam ablatively penetrates the dermal layers of the skin, the thermal radiation around the ablative canal heats up the surrounding healthy collagen and elastin fibers and they coagulate locally, causing the triple helix of the collagen fiber structure to shrink irreversibly. Hydrogen bonds that support the quaternary structure of collagen fibers or the structure of the triple collagen helix are most likely to be broken. There is a phenomenon of shrinkage of collagen fibers. Collagen elastin fibers are intricately organized

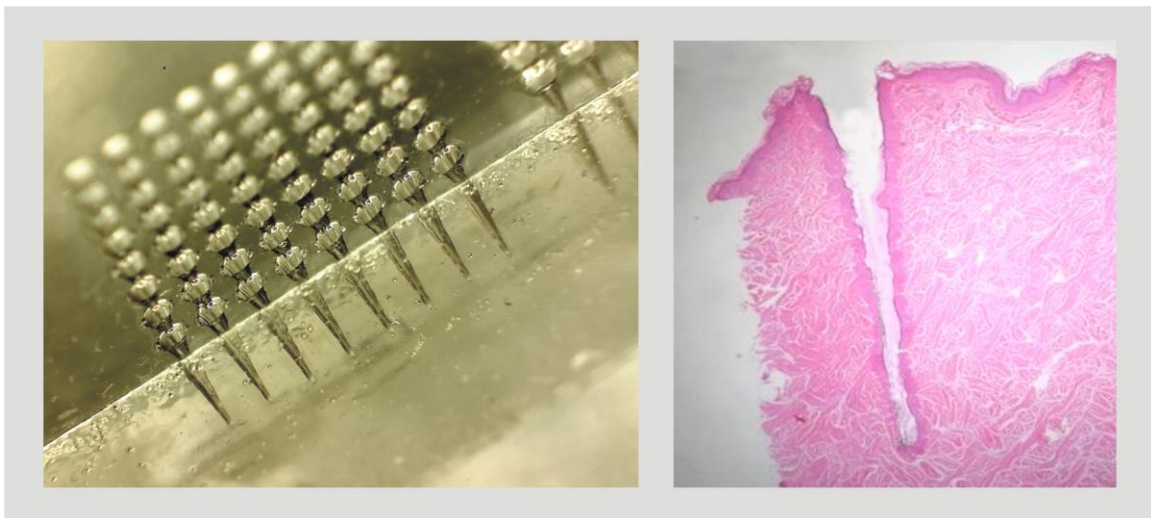
protein structures that form the "skeletal matrix" of the skin. They are not really vital, they are built by complex synthesis of fibroblasts and after their local thermal coagulation contraction, they are not replaced by new ones. New collagen synthesis is started when a wound occurs, such as fractional ablation itself. It breaks some collagen fibers, but "tightens" others. In the process of recovery, new collagen and elastine fibers in the ablative canals are formed in this shrunken state of the dermal matrix. In other words, the newly synthesized collagen strengthens the already shrunken dermal structure and this may explain the durability of the effect of the procedure. On the other hand, the layers of the reticular dermis are mechanically weakened by perforation. Retraction (shrinkage) of thermally loaded and other continuous collagen fibers is facilitated. This means that there is an optimal (golden) ratio between the density of the ablative canals, their diameter, and depth. The deeper the ablative canals, the more collagen fibers undergo both retraction and rupture. It is this phenomenon that is responsible for the lifting effect of the procedure, which can be observed visually in real-time during the ablative scan. A few minutes after the procedure, the onset of edema masks this initial retraction, but a week after recovery, significant shrinkage of the skin and smoothing of skin wrinkles were observed, observed in a comparative analysis of photographic documentation.

The newly synthesized collagen in the process of epithelialization is deposited between the folded connective tissue matrix, which serves as a reinforcing scaffold. Over the next 5-6 months, the newly synthesized collagen and elastin improve the elasticity of the treated skin area, remodel the skin and improve its turgor in the long run. The created biophysical model clarifies the phenomenon of instantaneous lifting effect, which is reported visually in the course of fractional scanning and serves to directly assess the effectiveness in this case. When ablative perforation is applied, the thermal irradiation scattering spreads radially around this perforation and the residual temperature away from the walls of the ablative canal is no longer sufficient for coagulation collagen retraction of the more distant collagen fibers. The next adjacent fractionated shot generates a new thermoradiation wave that meets and sums up the residual temperature of the previous ablative canal, so more collagen fibers between two ablative

canals can reach coagulation retraction at the optimal distance between two adjacent ablative perforations.



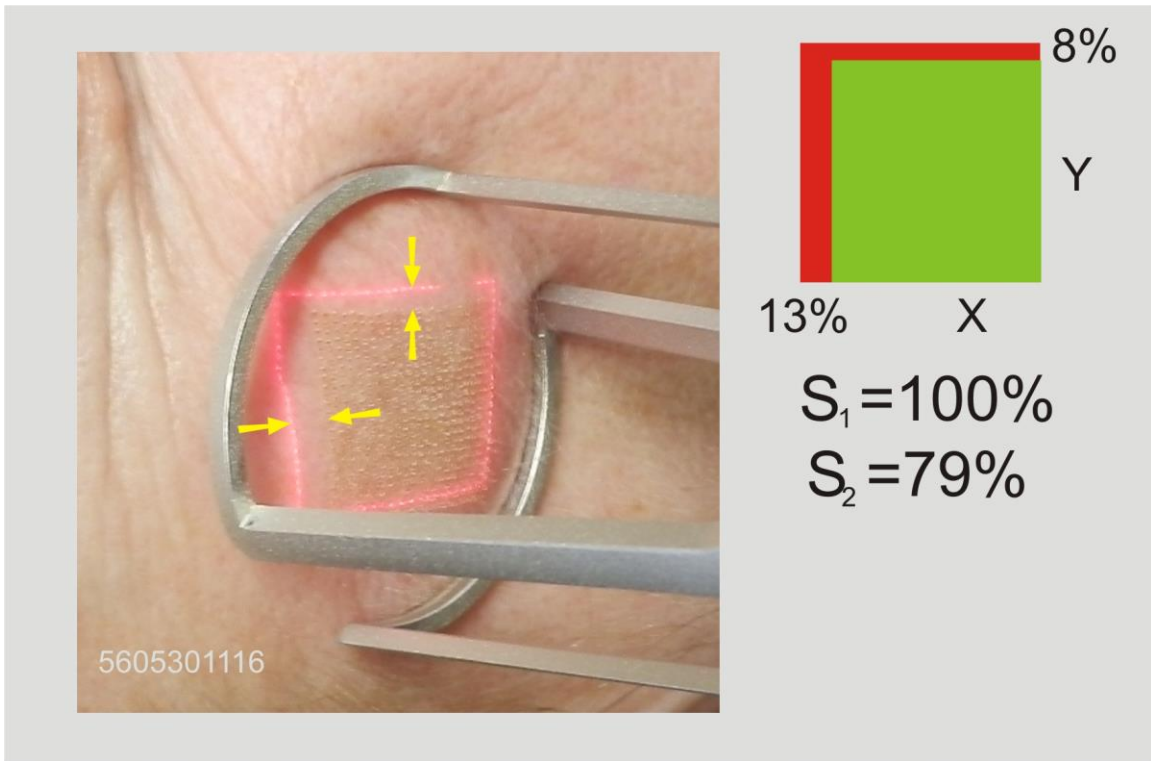
**Result of facial rejuvenation with deep laser resurfacing conducted 8 years ago. During this period, the patient did not perform other rejuvenation procedures but reduced her solar exposure. The photo-documentary comparison clearly demonstrates the effectiveness and durability of the procedure.**



**The fractionated ablative effect is well visualized in transparent acrylic. Histological picture of an ablative canal in the skin formed by the impact of 160 mJ pulse.**

The propagation time of the thermal wave depends on the thermal conductivity of the skin, which is determined mainly by tissue and cell water and can be considered relatively constant. The depth of the ablative canal depends to a small extent on the thickness of the epidermis and its hydration, and to the greatest extent on the energy light density. The higher the energy density, the deeper the ablative channels, respectively more surrounding collagen fibers in the cross-section of the dermis will shrink, but the overall thermal damage and aggressiveness of the procedure also increase. There are two main reasons why instantaneous retraction is not observed - either the energy in the pulse is very low or the distance between the fractionated perforations is very large.

The observed instantaneous retraction can be measured as a percentage by measuring the size of the sides of the square. The area of the traced field before the impact is larger than the area of the field after the laser ablative perforation scan. The physics of the process is as follows: when applying multiple ablative channels in the skin around each ablative crater, a zone of thermo-relaxation thermal damage is formed, in which the passing connective tissue fibers are not interrupted, but are subjected to coagulation retraction, which shrinks them. length. It is approximately 20 to 30%, depending on the density of the ablative channels and the energy parameters of the laser, the individual structure, and the thickness of the skin. The figures show that in different directions there is a certain difference in the contraction of the skin. This unequivocally proves the model for overlapping thermioradiation conversions between two perforation ablations. When starting the new perforation row, the perforations in the front row have already cooled down. This shows that if we want to achieve greater skin tension in a given direction, the perforation sequence must be in this direction, ie. the contraction in one row is more pronounced than in the direction of increasing the number of rows.



**The skin contraction in both directions depending on the direction of the successive fractional scan is demonstrated.**



**The photographs demonstrate the effect of instantaneous retraction of the collagen structure of the skin in the course of deep fractional exposure.**



**The same patient two weeks after treatment of the left facial half. Cutaneous elastosis is visibly affected. The observed erythema will disappear completely in a month and can be easily covered with light make-up.**

This physical model explains very well why in the mode of randomized application of the ablative channels during scanning the retraction is not so pronounced. Such a regime is advertised by manufacturers as heat-saving, which is true, but it is less effective because thermal radiation conversions do not intersect anywhere and each ablative channel "cools" until a new one is applied to it. The author's clinical experience has shown that it is difficult to determine the energy values required to obtain the maximum effect for a given skin type. The specification of the optimal parameters for each patient is done by conducting a therapeutic test session in which small individual fields are treated with different energy density. The energy density that has reached maximum efficiency is chosen as the working one.



**Area subjected to a test session before and two weeks after it.**



**The same patient 10 days after the treatment of the entire facial half with the selected energy parameters from the test session.**

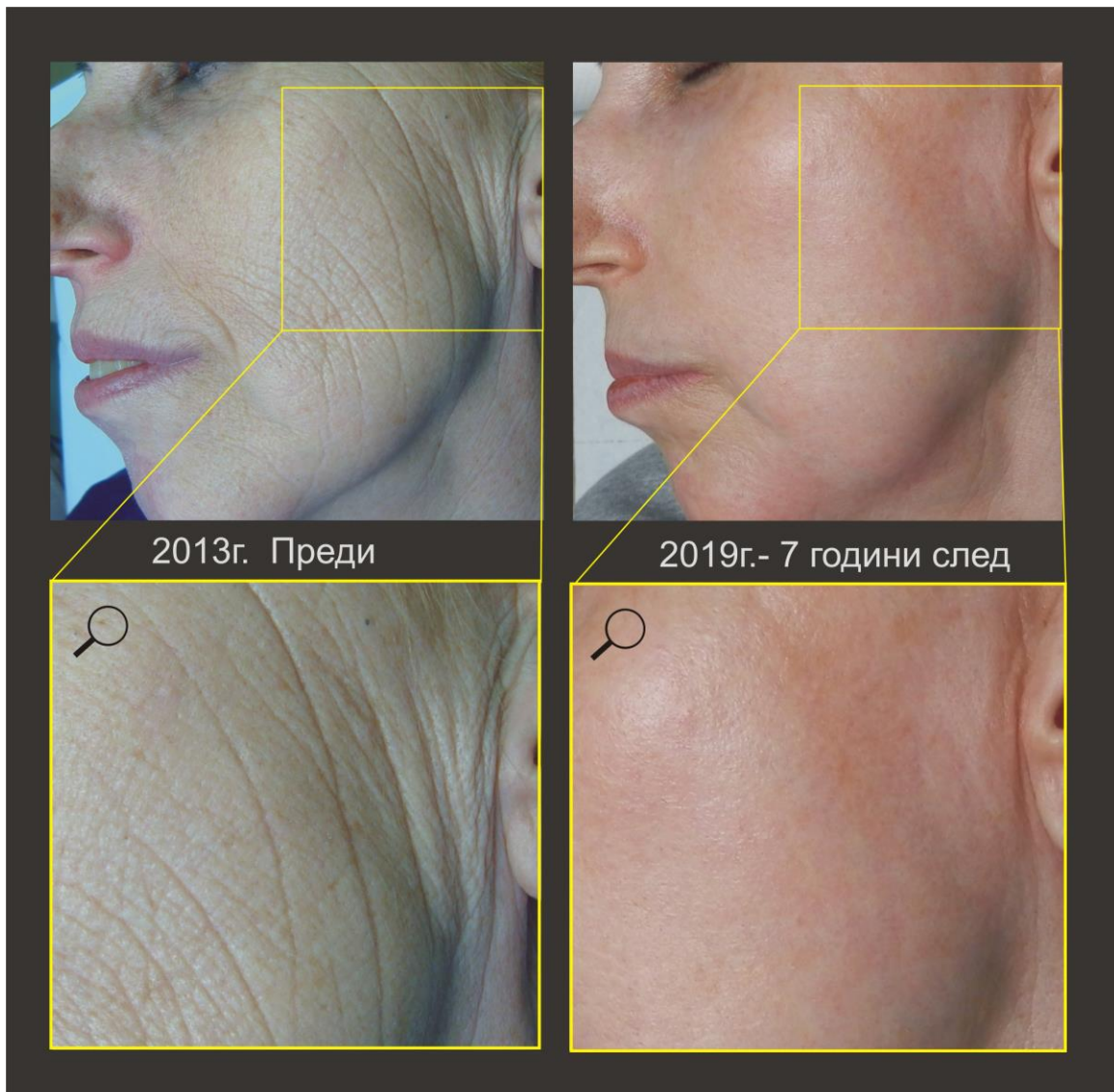
In practice, the test session had to be conducted unilaterally, in a larger field, not less than 25 cm, which has a greater informative value for both the patient and the attending physician, as this field is positioned in the area where wrinkles are most pronounced. Skin rejuvenation in this procedure is also due to increased microvascular dilatation and proliferation, expressed in erythema throughout the face, which subsides gradually up to 2 months after the procedure. This increased blood flow in the resurfacing area



provides more nutrients to the dermal layers and can be compared to a series of mesotherapy procedures. The process of vascular proliferation is part of an evolutionary regenerative mechanism for wound healing and this type of "mesotherapy" is much more natural and effective than the introduction of cocktails of vitamins and antioxidants with a "short needle".

Usually, periorbital and perioral wrinkles are deeper and more pronounced and in these areas zonal fractional treatment can be done after complete facial resurfacing or ultrapulse freehand point ablation can be done. The final effect of the procedure is reported after the removal of all crusts, as well as at three and six months. During the next autumn-winter season, a repeat procedure can be performed without a test session, because the expected effect is reported on the site of the initial unilateral test, on which the impact is two-lane and this informs the patient about the expected effect of the second procedure.

The skin tightening process can be further enhanced by performing a deep deep laser resurfacing a year or two after the initial procedure. Even the lifting effect is then even more pronounced, especially when the patient has observed strict photoprotection. This is explained by the fact that the photo-protected skin becomes thinner and softer and at the same energy parameters from the initial procedure, the ablative channels reach greater depth, respectively more collagen fibers undergo thermocoagulation retraction. In areas that are more relaxed, several zonal sessions can be held until the desired result is achieved. This is the area in front of the ear where several zonal procedures can be performed.



**The stretching of pronounced skin folds (excess skin) in front of the ear without surgical lifting is well demonstrated. The person underwent one procedure, but the area in front of the ear was treated 3 times with energy in the ablative channel 160mJ and a density of 144 ablative channels per square centimeter.**

Surgical scars often relax, forming a wide striated, hypopigmented, rough or atrophic scar. Ablative fractional laser resurfacing allows you to aestheticize and rejuvenate facial skin without the risk of grotesque facial expression, which can sometimes be observed after a surgical facelift. In my opinion, in many cases, it is appropriate to combine both techniques, as surgical lifting is limited to the removal of areas with pronounced sagging

skin, and laser resurfacing to smooth wrinkles, remove pigmentation and soften and rejuvenate the skin completely, contour the facial oval and to remove the scar from the surgical lift. It would be good to seek a balance in combining the two procedures, which in practice can not be done for a purely human reason - the professional medical ego.



**A 45-year-old patient with visible loss of elasticity and "fatigue" of the skin, undergoing deep laser resurfacing and skin appearance 2 years after the procedure. Significant rejuvenation of the facial appearance is reported. The sagging skin of the upper eyelids is also subjected to fractional laser blepharoplasty.**



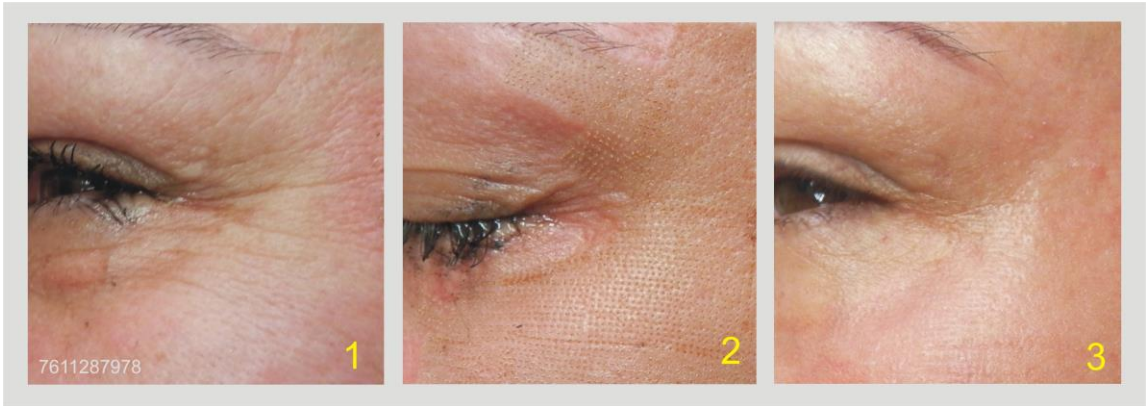
**Extremely unaesthetic scar after surgical lifting; wrinkles are removed but without improving the general condition of facial skin. This scar can be aestheticized with deep ablative zonal resurfacing in its atrophic part and ablation of the hypertrophic part after corticosteroid premedication. It is also desirable to conduct comprehensive facial resurfacing.**

The eyelids can also be subjected to fractional ablative effects, achieving significant skin shrinkage. The procedure is a very good alternative to surgical blepharoplasty and is associated with fewer side effects and higher aesthetics. Overseas, this laser procedure is popular as the Madonna Eyelift.



**Effect of a Madonna Eyelift procedure on a 50-year-old patient.**

Simultaneously with the fractional laser procedure on the eyelids, the area around the eyes can be treated to remove the so-called "Crow's feet" wrinkles.



**Stage of rejuvenation in the periorbital area.**



**Stage of rejuvenation in the periorbital area. The observed erythema will disappear in a month**

The fractionated laser procedure for rejuvenating the skin of the eyelids and periorbital area cannot lift the skin in one session to the same extent as classical surgical blepharoplasty, but it can be performed in several sessions until the desired result is obtained without risk of side effects. In surgical blepharoplasty, side effects such as visible scars and dilatation of blood vessels below the surgical incision are often observed, which should be masked with thick makeup. This side effect of surgical blepharoplasty is due to a change in the venous system of the eyelid due to the inevitable cutting of collateral branches between the superior palpebral vein and the medial palpebral vein, leading to compensatory dilatation of vessels that become visible through the delicate subcutaneous skin. The branches of the vascular system of the eyelids are strictly individual and therefore the occurrence of this side effect and the degree of its expression cannot be predicted in classical surgical blepharoplasty.

Three cases of the unaesthetic result after surgical blepharoplasty. The scar of the first photograph is slightly raised, hypopigmented and visible, and below it, the vessels are dilated and give a purple color to the lower part of the eyelid. The skin above the scar has fine lines and wrinkles. In the second photo, the surgical scar is less noticeable, but the dilated vessels are even more noticeable. There is also edematous thickening of the lash line, persisting for three years after surgery. In the third photograph, the incision has formed a visible scar with raised edges. In this case, the use of a laser correction procedure is appropriate. These side effects have not been observed with fractional Madonna Eyelift laser blepharoplasty.

#### **4.4.1 Discussion of the course of the recovery after CO2 ablative resurfacing**

Immediately after treatment, fading of the scanned area was observed due to vasoconstriction and partial obliteration of the vessels in the reticular dermis near the ablative canals. Subsequently, reactive erythema (pinkening or redness) of the treated area with mild to moderate plasma exudation and punctate bleeding from sites where the ablative canal has entered a larger capillary vessel has been observed. Exudation and slight bleeding indicate that the depth of the ablative canals has reached the reticular dermis.



**Immediately after exposure to the ablative canals, exudative plasma secretion and slight bleeding are observed, which is a sign that the ablative perforations have penetrated the dermal layers.**

At this initial stage, the patient experiences an uncomfortable burning and stretching sensation due to mild to moderate swelling, which can be effectively reduced with a topical cold compress in the first hours after the procedure. In practice, it turned out to be appropriate to use a package of frozen peas, but the pea balls in the package should not stick together. Cooling is done through dry and clean gauze or a towel to remove condensation water from the package. The peas cover the relief of the facial area evenly and thus cool it efficiently and not excessively. In some patients, a later and more pronounced edema reaction may occur - usually after the first or second day. It is advisable to limit the intake of salty foods and alcohol during this period in order to reduce the edema reaction in the area

with loose connective tissue around the eyes. In the treated area after the first day, point-like crusts (crusts) are formed, giving a startling look to the face, resembling severe thermal trauma.



**The dried plasma also covers healthy areas without ablative channels and mimics diffuse burns, which can mislead the patient or a doctor unfamiliar with the procedure.**

The thermal laser impact is fractionated and each ablative channel has a diameter of 150-200 $\mu$ m and the surrounding tissue is healthy. Reactive-inflammatory reactions of the skin are most pronounced in the first three days after the procedure, and at the end of the first week begin to exfoliate the crusts. In the first days, local fever is usually detected, which together with stress can provoke a herpes eruption in patients with a history of infection. In my practice, the use of antivirals (acyclovir, isoprinosine) before and after the procedure has not been able to prevent herpes outbreaks, and effective local cooling and informing the patient do a better job. After the fifth day, it is desirable to use moisturizing emulsions for sensitive skin to soften the formed crusts. The skin should not be wiped, but only lightly soaked with a gauze swab. No independent attempts should be made to mechanically remove the formed crusts, and when at the end of the first week they begin to peel themselves, the area can be washed with lukewarm water and carefully dried by soaking. Then apply moisturizer again, and when the crusts disappear completely, the area can be washed with lukewarm water without soap and then treated with moisturizing cosmetics, but without urea and perfume ingredients.



The clinical protocol of the FasetLift procedure is characterized by the fact that emollients are not constantly applied after it to remove the formed crusts. My clinical experience in performing this procedure has shown that epithelialization is faster and more natural when it takes place under a dry, naturally formed crust. This way of recovery is closer to the natural, evolutionary way of self-healing of the skin after injuries and does not create conditions for the development of pathogenic and microbial imbalance. The restored area after the fall of the crusts looks slightly swollen, with a pinkish-reddish color, with a barely perceptible pattern of ablative perforations. This erythema usually fades in two to three weeks and disappears completely within two months. The residual pattern of laser ablation is clarified and smoothed over the following months and gradually becomes invisible. During the first month, the treated area should be masked with corrective makeup powder, which also serves as an effective photoprotection and helps social security.

The use of sunscreens is not desirable due to the fact that their ingredients often irritate and irritate the newly epithelialized skin, and can not hide the erythematous appearance of the skin. Make-up powder, in turn, dries the skin and its removal is good to do with a moisturizing emulsion and it is appropriate to use more oily night creams.

In the world of dermatological practice, laser resurfacing with CO<sub>2</sub> fractionated laser is recognized as the "gold standard", as the most therapeutically and cosmetically effective. Disadvantages of the method include the need for a recovery period, detachment from social activity, and associated with ablation, although very rare, possible complications. Of course, when it comes to very deep perioral "barcode" wrinkles, a satisfactory result cannot be achieved with one procedure. In these areas, it is appropriate to spend repeated zonal procedures in the next season until the complete erasure of the wrinkles. The fractionated impact is carried out with high energy densities of 120-200mJ per ablative channel and a minimum of 150 micro ablative perforations per square centimeter in the mode of sequential application of ablative perforations.



**Result of facial deep ablative rejuvenation in a 60-year-old patient.**

The methods developed and widely advertised in recent years for non-ablative fractional laser rejuvenation, which can be performed without detachment from the social environment, are ineffective even after repeated repetitions. If the CO2 ablative laser resurfacing is performed with suboptimal parameters, its effect will also be invisible and the procedure meaningless. Very often doctors, fearing the aggressiveness of the procedure and lack of experience, perform it "homeopathically" - with low energy parameters and thus reduce it to a simple chemical peel. When performing the procedure with low energy levels, the impact will remain only in the layers of the epidermis and a real lifting effect will not be observed. The weak and insignificant effect of such a procedure leads to a loss of confidence in the effectiveness of therapy and fuels skepticism, which can unjustifiably place deep laser resurfacing among the many frankly fraudulent and ineffective procedures. The effect of a low-energy procedure can be compared and is even weaker than that obtained with chemical peels. It is in order to avoid an unsatisfactory end result that a therapeutic-predictive test is performed. It is an integral part of the clinical protocol of the FasetLift™

procedure and part of the mandatory informed consent. This test session guarantees correctness and good medical practice.



**Deep perioral wrinkles underwent two zonal sessions of deep laser resurfacing and a result three years after the procedure.**



**Result three years after a complete facial resurfacing of the patient from the previous photo. At this stage, a second procedure can be performed, which would completely smooth out the residual wrinkles.**



**Melasma removed with laser resurfacing before and one year after the procedure.**



**Early-stage (two weeks) of deep laser resurfacing in a 59-year-old patient. In the coming months, rejuvenation will intensify and "mesoerythema" will disappear.**



**Stages of unilateral fractional rejuvenation of a 53-year-old patient - perioral area selected for a test session (top, left); immediately after the procedure (top right); 5th day after the procedure (bottom, left) and result after dropping the crusts (bottom, right).**



**Pronounced solar elastosis affected by a deep laser resurfacing session performed unilaterally.**

#### **4.4.2 Discuss early and late reactions, limitations, and risks associated with the procedure**

The result of the test session may not be effective enough and the first procedure may be performed with no more than a 20% increase in energy density. Laser resurfacing with CO<sub>2</sub> laser is a relatively aggressive procedure and as the appearance of temporary swelling and crust formation leads to emotional discomfort in the patient, it is good to be detached from the work and social environment during the procedure.

#### **Pigmentation**

Hyperpigmentation may occur up to two months after epithelialization. It is more common in patients with darker skin (Fitzpatrick type III and IV) when the treated area is exposed to the sun during the recovery period or when retinol products are applied soon before or after the procedure. Before

applying resurfacing, it is mandatory to stop the use of any vitamin A (retinol) containing creams in order to prevent the occurrence of unwanted pigmentation. Aromatic compounds, perfumes, and cosmetics with perfume components should also be avoided during the recovery period for at least two months after the procedure and throughout the summer season, because photosensitizing reactions can be induced. Hyperpigmentation necessarily occurs after a visit to the solarium in the first few months after the procedure. Exposure to direct sunlight for at least three months after the procedure is strictly avoided. Visiting winter resorts is especially risky. Hyperpigmentation can be removed by superficial resurfacing at the beginning of the next winter period, but practice shows that it is transient and disappears during the winter months.

**Depigmentation** is a late side effect, much more common in IPL photorejuvenation or photoepilation, where epidermal melanocytes are largely diffusely destroyed in overdose. This side effect in IPL procedures usually occurs when the treated area has been heavily pigmented by sunburn and has been damaged by exposure to overdose. Depigmentation, as a side effect after deep laser resurfacing, has been described in the literature in the technique of full-field surfacing with ablative canal overlap, a technique that was used in the 1990s. Physically fractionated technique damages the epidermis in very small areas, in the places of the ablative canals (0.1 to 0.15 mm) and most of the surrounding melanocytes remain intact. In the following months, migrating melanosomes and melanocytes restore normal pigmentation. Permanent depigmentation is more likely to occur with overdose surface laser resurfacing (laser peeling), which generally works with a larger diameter and sometimes overlapping focal spots (0.5-2 mm). This side effect could occur when a more pronounced diffuse uncontrolled inflammatory process (impetiginization) has followed. In fact, after fractional laser resurfacing, the face becomes lighter, especially when it has previously been more intensely pigmented by sunburn. This lightening can not be called a side effect, but rather a concomitant positive effect of the procedure.

## **Swelling**

Cooling compresses with cryogenic applicators are used to prevent and reduce this early reaction that occurs immediately after the procedure. It is desirable to repeat at home within a few hours after the session. A good cooling effect is achieved with a package of frozen peas because good contact is made with the uneven geometry of the face. Care is taken to keep the treated area dry. Swelling is common mostly around the eyelids, upper cheeks, and forehead, but can spread below the chin and neck. It subsides over the next few days. Most often, more significant swelling can be observed in the first three days after the procedure. The swelling is less if you sleep less during these days and the body position is semi-lying down. Avoid salty foods and alcohol! In some patients with less subcutaneous and dry skin, swelling may not develop. Usually, in drier skin types and those with scanty subcutaneous and adipose tissue, the outflow is weaker.

## **Herpes**

The procedure leads to an increase in local skin temperature and this almost always induces the appearance of herpes simplex eruption, especially when treating the perioral (around the lips) area in patients with existing infection. The patient should be informed of this adverse reaction. For prevention, antiviral products - Acyclovir, Isoprenosine - can be prescribed a few days before the procedure, but in my opinion they are not effective enough. Hypothetically, a more serious inflammatory reaction could occur at the site of the herpes eruption, which must be managed in a timely manner with an antibiotic.

## **Candidiasis**

Observed side effects accompanied by itching and prolonged redness in the area undergoing resurfacing in some patients. It is most likely provoked in patients with impaired skin microbiome due to hyperhygienic habits, prophylactic use of antibiotics, or elevated blood sugar levels. Candidiasis is controlled by easily rinsing the area with acidified softened water. The change in pH stops the growth of the fungal colony, provoking itching.

The listed side effects are usually related to infection of the treated area, although extremely rare (less than 1%). They can occur if the condition is



not met to keep dry. Therapeutic minimalism after deep laser resurfacing is impaired only in case of impetigo with the appointment of a topical antibiotic and an oral antibiotic with pronounced skin accumulation (Azithromycin).

- Laser resurfacing is a therapeutic technique for rejuvenation of facial skin, which improves skin texture and elasticity, removes fine and deep wrinkles, corrects acne scars, stretch marks, rough scars caused by trauma, burns, surgery.
- The biophysics of the skin tightening process is the result of the phenomenon of coagulation retraction of collagen and elastin fibers.
- Deep ablative resurfacing is currently the most effective procedure that can improve the condition of the skin and actually eliminate the signs of aging. The results can be assessed as rejuvenation from a minimum of 5 to nearly 20 years.
- Ablative laser resurfacing allows to improve of skin turgor and aestheticizes and rejuvenates facial skin. There is no risk of grotesque changes in facial expression, which can sometimes be observed after surgical facelift or blepharoplasty.

## **5. Results and discussion of self-esteem changes, and their reflection on quality of life after aesthetic laser procedure**

For the purposes of the dissertation, a group of patients is monitored in the long term and at a follow-up examination (at least 6 months after the procedure) they fill out a questionnaire assessing changes in self-esteem through a sense of physical attractiveness and social confidence after rejuvenation and aestheticizing facial skin procedures. These data are used for statistical analysis in the dissertation, validating the real effectiveness and efficiency of the performed aesthetic-rejuvenating laser procedures. Understanding the connections of the psyche with the skin and the quality of life is of particular importance for specialists in dermatological practice because the skin is an integral part of the physical appearance, individuality,

and uniqueness of each individual. The condition and appearance of facial skin are related to self-esteem, and hence to the subjective quality of life. The conducted statistical analysis aims to validate the psychological effect of increasing self-esteem after aestheticizing and rejuvenating facial skin with the described procedures.

### **Hypothesis:**

It was assumed that the results of the procedures of the methodologies that are the subject of the dissertation will have a positive effect on self-esteem for appearance and overall self-esteem, expressed in their increase.

As described in Chapter 4, we used two self-assessment methods for self-assessment of appearance and a total self-assessment of a control group of 100 Caucasians, with Fitzpatrick skin types 2, 3, and 4. Patients have multiple benign unaesthetic lesions on the face and marked age-related skin changes. Patients with single and small lesions were not included in the group. The age of the subjects varied between 18 and 72 years ( $M = 46.17$ ,  $SD = 13.16$ ), (Table 1). Therapeutic and aesthetic removal of non-aesthetic dermatoses and skin rejuvenation is performed by fast-draw laser ablation (LFDA), one-shot ablation (OSA), and deep laser resurfacing. For research purposes, the participants fill in a psychological questionnaire of 2 self-report modules (Appendix 4):

1. Self-assessment of appearance - self-assessment scale, consisting of 11 items (Balabanova, 2018).
2. Multidimensional Self-Esteem Scale / Revised Janis-Field Scale, 24, (Fleming, Courtney, 1984).

Participants complete the psychological questionnaire twice - before the aesthetic laser procedure and not earlier than six months after it, as part of a second control examination.

Statistical analysis was performed with IBM SPSS Statistics, version 20. Statistical tools: descriptive statistics for quantitative data, frequency and percentage distributions, measures for central trend and scattering, methods for checking the normality of the distribution of quantitative variables, T-test for independent samples (Independent Samples T-Test), T-test for related

samples (Paired Samples T-Test), Pearson correlation, one-way analysis of variance. The significance level is  $p < 0.05$ .

## Results

	първо измерване	второ измерване
M	2,80	4,23
SD	0,79	0,53
skewness	0,147	-0,876
kurtosis	-0,242	0,458

**Table 2. Descriptive statistics on the scale of general self-assessment in the first and second measurements (before the procedure and at a late control examination not earlier than 6 months after it).**

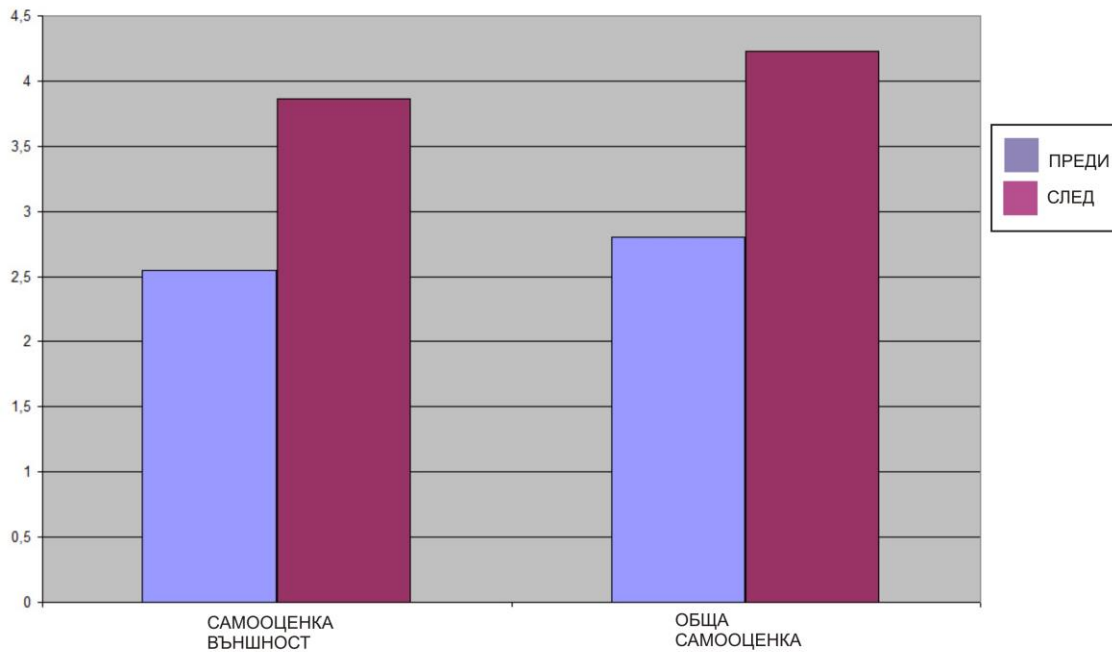
	първо измерване	второ измерване
M	2,55	3,86
SD	0,79	0,53
skewness	0,308	-0,185
kurtosis	-0,435	0,306

**Table 3. Descriptive statistics on the scale of self-assessment of appearance in the first and second measurements (before the procedure and at a late control examination not earlier than 6 months after it).**

The descriptive statistics of the General Self-Assessment and External Self-Assessment scales for the first and second measurements are presented in Tables 2 and 3. The distributions of the General Self-Assessment scale for the first and second measurements are close to the normal distribution. Coefficient of internal consistency alpha Cronbach on the scale of total self-assessment in the first and second measurements: - 0.86 and - 0.77, respectively. The presence of gender differences in the overall self-assessment was checked with a t-test for independent samples. In the first measurement there were no significant differences between men ( $M = 2.69$ ,  $SD = 0.90$ ) and women ( $M = 2.80$ ,  $SD = 0.77$ );  $t = -0.559$ ,  $p = .579$ . No such findings were found in the 2nd measurement: men ( $M = 4.26$ ,  $SD = 0.32$ ), women ( $M = 4.23$ ,  $SD = 0.56$ );  $t = 0.194$ ,  $p = 0.847$ . The distributions of the self-assessment scale for appearance in the first and second measurements are close to the normal distribution. The coefficients of internal consistency of alpha Cronbach in the 1st and 2nd measurements - 0.81 and 0.61. There were no gender differences in the self-assessment of appearance in the two measurements: men ( $M = 2.46$ ,  $SD = 0.56$ ) women ( $M = 2.59$ ,  $SD = 0.57$ );  $t = -1.077$ ,  $p = 0.284$ , and men ( $M = 3.86$ ,  $SD = 0.28$ ), women ( $M = 3.86$ ,  $SD = 0.38$ );  $t = 0.077$ ,  $p = 0.939$ . A t-test for pairwise comparisons was applied. A comparison was made between the average values in the first and second measurements of the external self-assessment and total self-assessment scales (Table 4; Graph 1). The data show that laser removal of dermatoses on the face and rejuvenation of the skin has a positive effect on self-esteem and overall self-esteem. Correlation analysis shows that the scales of self-esteem for appearance and general self-esteem are strongly related both before and after aesthetic procedures (respectively  $r = 0.62$ ,  $p < 0.01$ ;  $r = 0.49$ ,  $p < 0.01$ ). One-factor analysis of the variance of the data from both measurements showed a statistically significant impact of external self-esteem on overall self-esteem, with the effect of external self-assessment on overall self-esteem visibly different in patients with different initial levels of external self-esteem (Table 7, Chart 2).

променливи	М първо измерване	М второ измерване	разлика	t	p
самооценка за външността	2,55	3,86	-1,31	-18,993	0,02
обща самооценка	2,80	4,23	-1,43	-13,647	0,02

**Table 4. Average values in the first and second measurements of external self-esteem and overall self-esteem.**



**Graph 1. Levels of external self-assessment and general self-assessment before and after (before the procedure and at a late control examination not earlier than 6 months after it).**

ниво на самооценка за външността	обща самооценка - първо измерване			
	N	M	F	p
ниско	26	2,15	22,087	0,001
средно	27	2,98		
високо	28	3,30		

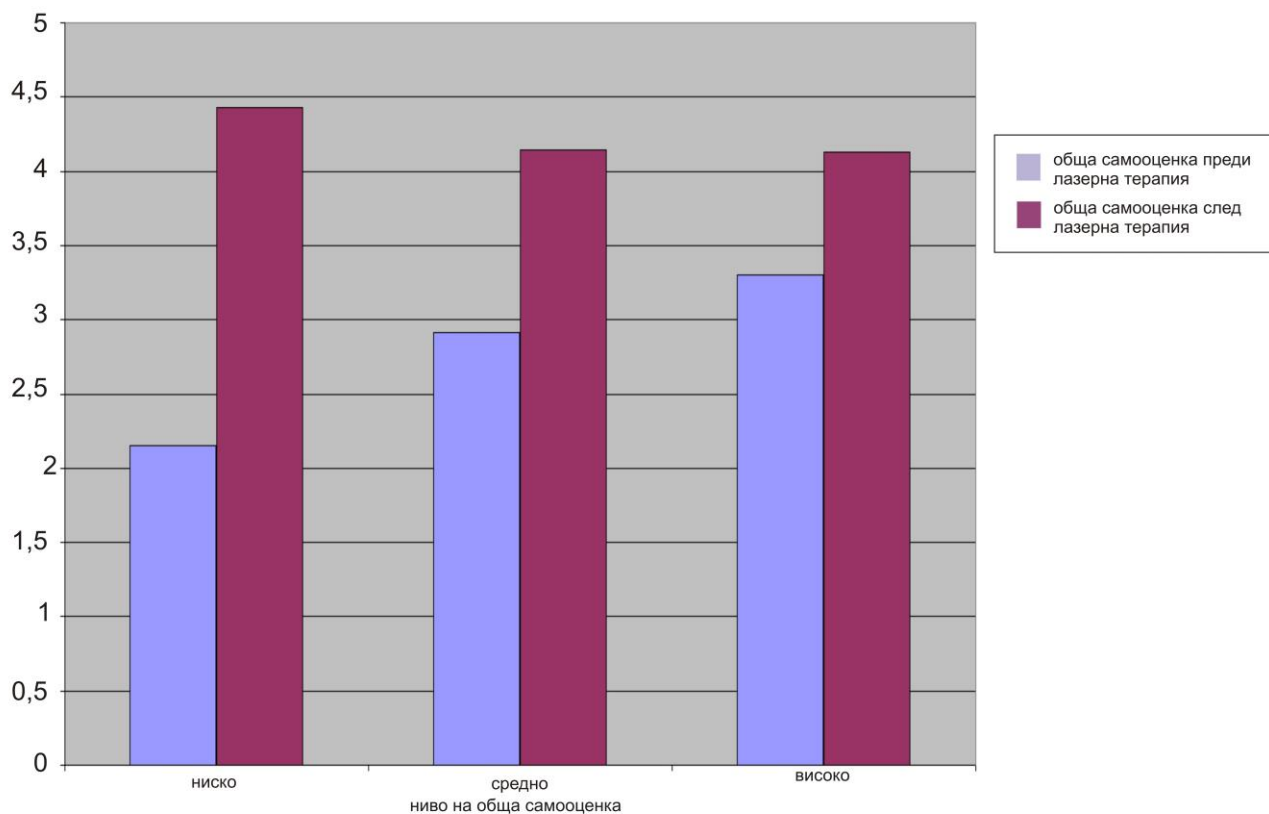
**Table 5. Self-assessment of appearance and general self-assessment at the first measurement (before aesthetic procedures).**

ниво на самооценка за външността	обща самооценка - второ измерване			
	N	M	F	p
ниско	30	3,92	10,630	0,001
средно	27	4,36		
високо	28	4,46		

**Table 6. Self-assessment of appearance and overall self-assessment in the second measurement (after aesthetic procedures).**

Ниво на самооценка за външността преди процедурите	обща самооценка				
	първо измерване	второ измерване	разлика	t	p
ниско	2,15	4,43	-2,28	-16,932	0,001
средно	2,91	4,14	-1,23	-7,825	0,001
високо	3,30	4,13	-0,83	-6,610	0,001

**Table 7. Total self-assessment values in the first and second measurements in patients with low, medium, and high initial level of self-esteem for appearance.**



**Graph 2. A graphic scale of general self-esteem in patients with low, medium, and high initial levels of self-esteem for appearance and values and after an aesthetic procedure.**

The results demonstrate a positive effect of aesthetic procedures on self-esteem for appearance and overall self-esteem, expressed in their increase (Chart 1). The data in Tables 5 and 6 indicate that in the first measurement the overall self-assessment depends more on the self-assessment for appearance. After the procedures, the influence of self-esteem on an appearance on the overall self-esteem decreases is statistically significant. The interpretation of this result is that patients are satisfied with the type and condition of facial skin. The analysis of Chart 2 clearly indicates that the increase in overall self-esteem is most significant in patients with initially the lowest level of self-esteem for appearance (Table 7, Chart 2). It should be borne in mind that the increase of both psychological parameters can probably hypothetically have higher real values because it is typical for people not to admit even before themselves their low self-esteem.

## **6. DISCUSSION OF A THERAPEUTIC PLAN FOR PERSONALIZED AESTHETICS AND REJUVENATION OF FACIAL SKIN**

The development of a therapeutic plan for aestheticizing facial skin is required by the individual characteristics of each skin type and the degree of damage to it. According to the specific needs of each patient, an individual treatment plan is prepared. The stages are discussed with the patient. Information on the expected therapeutic and aesthetic result and possible complications and side effects is provided. The patient's expectations are discussed and photo-documentary material reflecting laser procedures on similar dermatoses in patients of the same age and the same skin type according to Fitzpatrick is discussed. This discussion is an integral part of correctly informed patient consent.

A patient file is prepared with results from dermatoscopic, histological, and other examinations and photo-documentary material of the lesions and the condition of the facial skin. The dermatoses that worry the patient the most are discussed. The possibility of removing lesions on the trunk is discussed, which will further improve personal psychosocial comfort and aesthetics of the skin as a whole. At this initial stage, pigmented lesions (dysplastic nevi, solar lentigo, etc.) with an optional or obligate precancerous character are carefully evaluated. Photo-documented digital dermatoscopy of lesions with risk deviations is performed. In case a lesion with borderline dysplastic characteristics or violated risk criteria (asymmetry, color, board, diameter) is found, the patient is referred for surgical excision, explaining that in non-aesthetic scarring, which he fears, there are laser methods. for its deletion. The first stage of the therapeutic plan includes removal of benign non-aesthetic lesions, which are most strongly associated with damaged skin and old age - seborrheic keratoses, solar keratoses, solar lentigo, sebaceous hyperplasia, cherry angiomas, venectasia, milia, warts, and xanthelasma. The practice has imposed a method of unilateral removal of lesions when they are multiple.





SH - Sebaceous Hyperplasia,  
 DN - Dermal Nevus,  
 SK - Seborrheic Keratosis,  
 BCC - Basal Cell Carcinoma,  
 SP- Solar Pygmentation,  
 IFK - Inverted Follicular Keratosis,  
 FRS - Comedo or Favre-Racouchot  
 Syndrome

**87-year-old patient with multiple and different skin lesions on the background of photoinduced skin elastosis. All lesions were removed unilaterally in one session. At the control examination, the result is analyzed, missed or residual lesions are removed and the other half of the face is treated.**

\* photographs are published with the patient's permission.

This approach allows the patient to see the results and make a comparison with the other (untreated) half of his face, which stimulates him to complete the treatment. When non-aesthetic lesions are few in number or

single, removal is done all over the face in one therapeutic session. Epidermal lesions (multiple seborrheic, actinic keratoses, dermatosis papulosis nigra, cherry angiomas, angiofibromas, etc.) are treated - ablated or thermocoagulated with low power densities of 200-500 W / cm<sup>2</sup>, as fast as possible, without any cost removing them in one session with the described techniques. Any excess load on the underlying dermis may be associated with gross and visible scarring. The application of high power densities, achieved by reducing the focal spot and not by increasing the output laser power by the described techniques guarantees the aesthetic result of the therapy. The second stage includes the first control examination. The first follow-up examination is scheduled no earlier than 6 weeks after the first therapeutic session. It evaluates the effectiveness of the therapy and possible complications (such as a tendency to a keloid reaction, the appearance of pigmentation, or noticeable scarring). At this stage, the removal of missed lesions and correction of the treated ones is performed. The sites of lesions that have already been removed are still slightly erythematous, and this erythema disappears completely in the following months. Sometimes this erythematous reaction worries patients and they should be informed of its disappearance. The first follow-up examination is combined with a second therapeutic session. The lesions in the other, untreated half of the face are removed. The third bump is an early check-up for control and revision of the whole face, neck, and décolleté. After a period of six months to a year, a late follow-up examination is performed, which assesses and inspects the skin in detail. At this stage, when all the dyschromic changes from the manipulations have finally disappeared, very small missed and new lesions can be detected and removed. Visually, the clinical orange in the removal of multiple dermatoses on the head is carried out in four steps, illustrated as follows:

## Clinical protocol for the removal of multiple non-aesthetic dermatoses



**Step 1**

Първи сеанс - унилатерално отстраняване на всички себорейни и соларни кератози в лявата половина на лицето.



Втори сеанс след месец. Ревизия на лявата половина за отстраняване на пропуснати и остатъчни лезии.



Отстраняване на всички лезии в дясната половина на лицето.

# Step 2

# Step 3

Трети сеанс за контрол и корекции на цялото лице след месец

# Step 4

Четвърти сеанс. Контролен преглед след шест месеца



**A typical example of ablative total removal of many small pigmented dermal nevi and pigmentation without noticeable scarring. A surgical approach, in this case, would be unjustified and would be associated with visible scarring.**

\* photographs are published with the permission of a patient



**A 60-year-old patient with multiple seborrheic keratoses removed by rapid and one-shot laser ablation using a unilateral approach. No visible scarring was detected and the face was visibly rejuvenated.**

\* photographs are published with the patient's permission

All control examinations are photo-documented and compared with the initial photographs. Patients are acquainted in detail with the necessary measures for adequate photoprotection, correction of hygienic behavior and appropriate cosmetics can be selected.

At the control examinations, the gerontological condition of the skin can be assessed - the presence of elastic manifestations, pronounced wrinkles, skin atrophy, melasma, dyschromia, loss of turgor and elasticity, and possibilities for erasing these senile manifestations are discussed. When these changes are not yet pronounced, ablative rejuvenation procedures are postponed, but in no case are they performed prophylactically.

The patient is acquainted with the possibilities and measures for slowing down the processes of photoaging of the skin and correction of hygienic habits and skincare so as to preserve and balance the skin microbiome. During the recovery period, between the individual therapeutic sessions, the patient is informed about the possibilities for smoothing and rejuvenating the facial skin with the help of ablative-fractionated laser procedures. A test session can be performed with the treatment of a small (up to 25cm<sup>2</sup>) area with pronounced elastic changes and wrinkles. This test and its result are a scale model of the overall facial resurfacing and acquaint the patient with the possibilities and effectiveness of the procedure, how it will affect his skin, how the recovery process, and what to expect as a final result. The test also prevents unrealistic expectations from the procedure. The test session has a predictive value for the patient and is informative for the attending physician for individual correction of the parameters (energy density, ablative density, etc.) for conducting the overall facial resurfacing.

The deep laser resurfacing procedure is performed not earlier than 6 months after the total elimination of all pathological formations on the face when the epithelialization processes are completed. It is performed during the autumn-winter period in order to reduce edema and the appearance of unwanted pigmentation. After deep ablative fractional resurfacing, the surface laser resurfacing procedure can be performed. It further smoothes the skin pattern and renews the epidermal layers of the skin, removes residual epidermal pigmentation. Increased erythema and increased blood flow in the first months after the procedure help nourish the skin, which further improves the condition and its structure. Completion of collagen synthesis in ablative perforations and regenerative restructuring of collagen in the next few months enhance the effect of the procedure and it is also reported by others. The rejuvenating effect can be enhanced with dosed hyaluronic fillers and Botox.



**A 50-year-old patient with solar-damaged skin underwent two sessions of deep fractionated CO2 laser resurfacing. After the procedure, the patient's lips were corrected with a hyaluronic filler, which emphasizes the effect of the rejuvenation.**

\* photographs are published with the patient's permission

The removal of non-aesthetic dermatoses and the rejuvenation of the facial skin with the considered laser effects have a favorable effect on the self-esteem for the appearance and the general self-esteem. The applied statistical analysis on the changes in the self-assessment for the appearance and the general self-assessment after laser aestheticizing influences provide empirical data that confirm the hypothesis. They validate the effectiveness of the author's therapeutic and aesthetic methods discussed in the dissertation and their positive impact on the self-esteem of the subjects. The removal of non-aesthetic dermatoses and rejuvenation of the facial skin with the considered effects has a beneficial effect on self-esteem and general self-esteem, which is an important factor for emotional well-being and subjective quality of life in the spheres of social and personal realization.



## **7. SUMMARY**

1. The therapeutic efficacy of the application of ablative CO2 laser effects proves that they are a suitable therapeutic alternative, providing high aesthetics of the end result in the removal of pathological lesions on the face.
2. The developed author's CO2 laser methodology is effectively effective in the treatment of prolonged juvenile and adultorum acne, and fractionated ablative procedures can erase the signs of severe acne.
3. Laser resurfacing performed with optimized parameters is a therapeutic technique for significant rejuvenation of facial skin, which really improves skin texture and elasticity, erases fine and deep wrinkles, and corrects acne scars, and rough scars caused by trauma, burns, and surgery.
4. The removal of non-aesthetic dermatoses and the rejuvenation of the facial skin with the considered laser effects has a favorable effect on the self-assessment of appearance and overall self-assessment.

## **8. CONCLUSIONS**

The therapeutic and aesthetic efficacy of the CO2 laser shows that it is particularly suitable for the removal of all benign skin lesions in the head and neck area except venectasias and decorative tattoos.

Laser ablation, thermolysis and excision are suitable for the removal of unaesthetic dermal melanocyte nevi, papillary nevi, and those that are pediculous. They are suitable for multiple, smaller nevi and solar lentigo, for which surgery is unwarranted or may be associated with gross scarring and keloids.

Laser ablation is suitable for multiple lentiginous pigmentations of varying intensity on the face, neck, décolleté, and shoulders. The developed clinical protocol for work in the unilateral area allows the aesthetic removal of all benign dermatoses in the selected half such as cherry angiomas, seborrheic keratoses, papillomas, flat warts, actinic keratoses, epidermal cysts, milia, and others. In the treated half, all dysplastic nevi, for which their surgical removal or observation is discussed, are left, photo-documented and dermatoscoped. The unilateral approach in clinical oranges

with early and late examinations is especially important to achieve an aesthetic end result in multiple benign lesions in order to avoid reinsurance overdose, which would be associated with gross scarring. At the first follow-up examination after 40 to 60 days, all missed and residual lesions are easily detected on a clean background in the area and are delicately ablated. This period is sufficient to visualize the pigmented retinas of the recurrent nevus, which are benign and easily removed, with ablation at the point of initial melanocyte growth ablating deeper.

Laser ablation is a good alternative for the removal of non-advanced basal cell carcinomas of the face in patients who have refused surgery and those with contraindications for surgery. The ablative technique gives some advantages, one of which is that the ablated wound surface is left for free epithelialization under the crust. In this approach, residual microscopic neoplastic loci are not encrypted under the suture and their evolution into eventual recurrence visualizes them in loose granulation tissue. They are easily detected and removed as part of the mandatory inspection. Patients are informed of the likelihood of recurrence and are monitored within five years. Laser ablation is not appropriate in areas at risk for perineural and perivascular advancement - neck and angular areas and patients should be convincingly and persistently referred for surgery.

The author's laser method for the treatment of prolonged adult acne presented in the dissertation is highly effective and gives results after the first procedure. It is also suitable for the exhaustion of therapeutic drug efficacy in juvenile acne, which threatens to become chronic and lead to severe scarring and impaired skin relief. The effectiveness of the developed author's methodology applied to long-term acne adultorum shows that the problem can be effectively and definitively solved without medication. Once the acne picture has been controlled, scarring, relief, and scarring can be effectively treated with deep fractional laser resurfacing.

Laser resurfacing is a therapeutic technique for rejuvenation of facial skin, which really improves skin texture and elasticity, erases fine and deep wrinkles, and corrects acne scars, rough scars caused by trauma, burns, and surgery. Deep ablative resurfacing is an effective procedure that can improve the condition of the skin and actually erase the signs of aging - elastosis,

wrinkles, dyschromia. The results can be assessed as rejuvenation from a minimum of 5 to nearly 20 years.

The removal of non-aesthetic dermatoses and the rejuvenation of the facial skin with the considered laser effects have a favorable effect on the self-esteem for the appearance and the general self-esteem.

The described therapeutic laser methods provide high aesthetics of the end result and a number of advantages:

- laser manipulations are performed in an outpatient setting;
- the treated field is self-sterilized and does not require antiseptics and postoperative medication;
  - no surgical instruments are used where there is a risk of contamination with bacterial, viral, and prion particles;
  - the laser manipulations are bloodless, as in the excised section and the ablated surface the blood vessels are coagulation glued;
  - the operative time for lesion removal is extremely short; multiple lesions can be removed in one laser session;
  - no need for stitches and bandages. The coagulation crust on the wound surface acts as a reliable bandage during the epithelialization period and can be easily covered with makeup;
  - the postoperative period is without edema in most cases, or if such is observed, it is transient;
  - the hair follicles of the eyebrows, eyelashes, and capillaries and their anatomical inclination are spared;
  - when removing lesions on the lash line convexity and contour is not violated;
  - no bruises are observed, which are almost mandatory for surgical interventions in the eyelid area;
  - when working on the eyelids and near the eye, the procedure is completely safe for the patient's vision with simple precautions and means;
  - when removing lesions on the auricle, the perichondrium is spared, the contour and geometry are preserved;
  - When working with a CO2 laser, the operating field is not spectrally limited by the use of filter glasses, as with all other lasers. You can work with ordinary prescription glasses;

- The cost of a laser procedure is significantly lower than that of surgical procedures - no anesthesiologist, nurse, operating room, and consumables are needed.

The clinical protocol described here, tailored to the individual characteristics of each patient, is a modest contribution to inclusion in the new approach in modern personalized medicine.

## **9. CONTRIBUTIONS**

The dissertation provides contributions with the potential to be widely applied in dermatological practice. Effective methods that really improve the appearance and condition of the skin are systematized and analyzed. These methods have been studied, applied, and optimized by the author for more than 30 years of clinical experience. The therapeutic range and effectiveness in removing a number of dermatoses that compromise facial aesthetics are outlined. The contributions are important for clinicians, dermatologists, and surgeons, students of dermatology and surgery, as well as researchers, engineers, and designers of medical laser systems. This issue is directly related to the understanding of the importance of skin condition as a factor for self-esteem, and hence for quality of life. The following contributions are displayed:

### **9.1 Scientific and theoretical contributions**

1. Laser ablation is redefined as thermoradiation self-limiting ablation and is used by the author as two techniques - Laser Fast Draw Ablation (LFDA) and One Shot Ablation (OSA). This terminology and techniques, as well as their abbreviations, are introduced by the author and are described for the first time here.

2. Laser ablation at 10600 nm is considered not as a non-selective effect, but as a controllable physical process for ablative destruction of bulky pathological lesions with maximum sparing of the underlying and surrounding tissue structures. This control is done with appropriate radiation modulation, selection of optimal energy density, ablative spot size, and crawl rate.

3. A new physical model for skin retraction in ablative laser resurfacing is described, due to irreversible structural changes in the triple helix of collagen, explaining the lifting effect.

4. An original contribution is the author's approach to skin pathology and regenerative processes an evolutionary aspect.

5. The understanding of selective laser thermolysis is clarified and revised.

## **9.2 Scientific and applied contributions**

1. The possibility of removal in outpatient conditions of all pathological lesions with only one type of laser (CO2 laser) is demonstrated using optimized techniques for high-speed ablation with high energy density, small focal spot, and fast bypass.

2. Techniques are provided for the removal of various non-aesthetic dermatoses in areas at risk of complication using other methods and an effective alternative to some classical approaches.

3. The understanding of the etiology and pathogenesis of acne in the evolutionary-anthropogenic aspect is supplemented.

4. A clinically tested new therapeutic approach for non-drug definitive treatment of exacerbated juvenile and adult acne has been developed.

5. A clinical protocol has been created for conducting the procedure for rejuvenation of the facial skin with deep ablative laser resurfacing.

6. A therapeutic plan has been created with an effectively optimized clinical protocol for complete aestheticization and rejuvenation of the facial skin with laser methods. The clinical protocol itself is an innovative contribution to the individual approach to each skin, taking into account its individual characteristics.

7. A practically applicable psycho-therapeutic unilateral protocol is provided, which helps to optimize the communication between doctor and patient in the understanding of the expected end result of the therapy.

8. Psychological work is introduced with the patient to detect accentuation and obsessive-compulsive disorder related to hyper hygienic or pathological actions that sabotage any acne therapy.