

## References

1. Bálint A, Dóczi I, Bereczki L, Gyulai R, Szucs M, Farkas K, et al. Do not forget the stool examination! – Cutaneous and gastrointestinal manifestations of Blastocystis sp. infection. *Parasitol. Res.* 2014; 113:1585–1590. doi: 10.1007/s00436-014-3805-0.
2. Beghini F, Pasolli E, Truong TD, Putignani L, Cacciò SM, Segata N. Large-scale comparative metagenomics of Blastocystis, a common member of the human gut microbiome. *ISME J.* 2017; 11:2848–2863. doi: 10.1038/ismej.2017.139.
3. Dagci H, Kurt Ö, Demirel M, Mandiracioglu A, Aydemir S, Saz U, et al. Epidemiological and diagnostic features of Blastocystis infection in symptomatic patients in Izmir province, Turkey. *Iran. J. Parasitol.* 2014; 9:519–51929.
4. Deng L, Wojciech L, Gascoigne NRJ, Peng G, Tan KSW. New insights into the interactions between Blastocystis, the gut microbiota, and host immunity. *PLoS Pathog.* 2021;17: e1009253. doi: 10.1371/journal.ppat.1009253.
5. Gancho OV, Moshel NM, Boychenko OM, Bublil TD, Kostyrenko OP, Popovich IYu, et al. Herbal medicines antimicrobial effect. *Georgian medical news.* 2022; 7(328): 88–91.
6. Nourrisson C, Scanzi J, Pereira B, NkoudMongou C, Wawrzyniak I, Cian A. Blastocystis is associated with decrease of fecal microbiota protective bacteria: comparative analysis between patients with irritable bowel syndrome and control subjects. *PLoS One.* 2014 Nov 3;9(11): e111868. doi: 10.1371/journal.pone.0111868.
7. Rudzińska M, Sikorska K. Epidemiology of Blastocystis Infection: A Review of Data from Poland in Relation to Other Reports. *Pathogens.* 2023 Aug 16;12(8):1050. doi: 10.3390/pathogens12081050.
8. Scanlan PD, Stensvold CR, Rajilić-Stojanović M, Heilig HG, De Vos WM, O'Toole PW, et al. The microbial eukaryote Blastocystis is a prevalent and diverse member of the healthy human gut microbiota. *FEMS Microbiol Ecol* 2014; 90: 326-30.
9. Scavizzi F, Ryder E, Newman S, Raspa M, Gleeson D, Wardle-Jones H, et al. Blastocyst genotyping for quality control of mouse mutant archives: an ethical and economical approach. *Transgenic Res.* 2015 Oct;24(5):921–7. doi: 10.1007/s11248-015-9897-1.
10. Seyer A, Karasartova D, Ruh E, Güreşer AS, Turgal E, Imir T, et al. Epidemiology and Prevalence of Blastocystis spp. in North Cyprus. *Am J Trop Med Hyg.* 2017 May;96(5):1164–1170. doi: 10.4269/ajtmh.16-0706.
11. Stensvold CR, Clark CG. Current status of Blastocystis: A personal view. *Parasitol. Int.* 2016; 65:763–771. doi: 10.1016/j.parint.2016.05.015.

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I.A. Mamedkhanova, G.S. Mamedova, M.Y. Ismailova, S.I. Rustamzade<sup>2</sup>

Azerbaijan Medical University, Baku, Azerbaijan

<sup>1</sup>Azerbaijan State Doctors Training Institute named after Aziz Aliyev, Baku, Azerbaijan<sup>2</sup>Expert Laser Medical Center, Baku, Azerbaijan

## THE IMPACT OF ABLATIVE LASER THERAPY ON VARIOUS TYPES OF SKIN AGING

e-mail: mic\_amu@amu.edu.az

The purpose of the study was to evaluate changes in facial skin during the use of an ablative fractional laser depending on the morphotype of ageing. 72 patients with involutive skin changes were involved. Group I included 29 patients with a deformative morphotype, Group II included 20 patients with a finely wrinkled morphotype, and Group III – 23 patients with a mixed morphotype. The ablative fractional photothermolysis procedure was carried out using a CO2 laser. To assess the results visual analogue scale and FACE-Q Satisfaction with Skin were used. After therapy, the total score on the FACE-Q Satisfaction With Skin in Group I increased by 42.5 %, in Group II – increased by 40.7 %, in Group III – increased by 41.7 %. After 6 months in the Group I the percentage of patients with preserved effect was 93.1 %, in Group II – 95 %, in Group III – 95.6 %, after 12 months – 86.2 %, 85 % and 87 %, respectively. Thus, fractional laser has high effectiveness in therapy for all types of aging.

**Key words:** morphotype of aging, fractional photothermolysis, dermatological scale, wrinkles

I.A. Мамедханова, Г.С. Мамедова, М.Ю. Ісмаїлова, С.І. Рустамзаде

## ВПЛИВ АБЛЯЦІЙНОЇ ЛАЗЕРНОЇ ТЕРАПІЇ НА РІЗНІ ТИПИ СТАРІННЯ ШКІРИ

Метою дослідження було оцінити зміни шкіри обличчя під час використання абляційного фракційного лазера залежно від морфотипу старіння. У дослідженні взяли участь 72 пацієнти з інволютивними змінами шкіри. До I групи увійшли 29 пацієнтів з деформаційним морфотипом, до II групи – 20 пацієнтів з дрібноморщинистим морфотипом, до III групи – 23 пацієнти зі змішаним морфотипом. Процедура абляційного фракційного фототермолізу проводили з використанням CO<sub>2</sub>-лазера. Для оцінки результатів використовували візуальну аналогову шкалу та FACE-Q Satisfaction With Skin. Після терапії загальний бал FACE-Q Satisfaction With Skin у I групі збільшився на 42,5 %, у II групі – на 40,7 %, у III групі – збільшився на 41,7 %. Через 6 міс у I групі відсоток хворих із збереженим ефектом становив 93,1 %, у II групі – 95 %, у III групі – 95,6 %, через 12 міс – 86,2 %, 85 % та 87 % відповідно. Таким чином, фракційний лазер має високу ефективність в терапії всіх типів старіння.

**Ключові слова:** морфотип старіння, фракційний фототермоліз, дерматологічна шкала, зморшки.

Skin aging is a complex biological process that occurs under external and internal factors. External factors, first of all, mean various factors that affect the skin from the outside, including the harmful effects of sunlight. In addition, factors such as cigarette smoke, alcohol, physical inactivity, poor diet, hormonal dysfunction, etc. play an important role in the occurrence of photoaging Internal factors are associated with

stress, traumatic injuries, various diseases of internal organs, and metabolic disorders [2]. Exposure to ultraviolet rays (UV) causes solar elastase, extracellular matrix degradation, and wrinkles in human skin. At the same time, after a certain time, natural aging of the skin occurs due to the influence of genetic factors. These two (external and genetic) processes are synergistic in nature with the same clinical signs [15].

During skin aging, histologically, atrophy of the epidermis and a decrease in the amount of collagen and fibroblasts occur. According to many researchers, with age, the number of Langerhans cells, mast cells, and melanocytes in the epidermis decreases, which leads to functional changes in the skin. With age, wrinkles appear on the facial skin, and the epidermis becomes thinner [2, 10].

According to the team of researchers, changes caused by UV exposure in the skin are different from changes caused by natural aging. Thus, during photoaging, the thickness and morphology of the epidermis varies. In one case, the epidermis is thicker and epidermal atrophy occurs during photodamage [13].

Regardless of the type of aging process, decreased skin elasticity and the appearance of wrinkles are accompanied by the formation of dermal atrophy as the main symptom [12].

There are a lot of medications and products used to prevent skin aging, and the main ones are: retinoic acid, ascorbic acid, glycolic acid, etc. [6].

One of the popular methods is using of ablative fractional laser. Ablation is widely used in other areas of medicine due to its advantages as less traumatic and associated with lower risks of bleeding and pain [9]. Ablative fractional laser resurfacing has been shown to be effective in counteracting photoaging through entire epidermal ablation, collagen shrinkage, stimulation of neocollagenesis, extensive dermal remodeling, regeneration of cellular organelles and intercellular attachments, but this method is associated with risks of severe long lasting side effects (persistent erythema, hypo- or hyperpigmentation, infection or scarring). Recently, fractionated CO<sub>2</sub>-, erbium glass or erbium-YAG lasers have been introduced to reduce downtime and side effects [3, 11]. Fractional lasers heat the skin, regulate matrix modeling, and also stimulate the biosynthesis of collagen types I and III [8]. Studies have shown that after 2–3 fractional laser (CO<sub>2</sub>) treatments, skin texture changed, wrinkling decreased and cosmetic results improved [7, 12, 14].

**The purpose** of the study was to evaluate changes of facial skin during the use of ablative fractional laser depending on the morphotype of aging.

**Materials and methods.** A comparative longitudinal prospective study was conducted at the Department of Dermatovenerology of the Azerbaijan Medical University and Expert Laser Medical Center in the period from 2018 to 2022. The study involved 72 patients with involutive skin changes. To study the effectiveness of ablative fractional laser in the treatment of involutive skin changes, 3 comparison groups with different morphotypes of aging were formed.

Group I included 29 patients with a deformative morphotype, Group II included 20 patients with a finely wrinkled morphotype, and Group III – 23 patients with a mixed morphotype. All participants signed informed consent for the procedures and for participation in the study. To assess the results, dermatological scales (visual analogue scale – VAS, FACE-Q Satisfaction with Skin) were used.

Studying the severity of clinical signs of involutive skin changes using a VAS on a point system from 1 to 10 includes the following indicators: xerosis, color, pigmentation, turgor, elasticity, expression wrinkles, gravitational wrinkles.

Self-assessment of the initial condition of facial skin, as well as after completion of the course of procedures, was performed by study participants using the FACE-Q Satisfaction with Skin questionnaire. Patients rated their satisfaction with their skin condition using 12 indicators: shine (radiance), hydration, smoothness, healthy appearance, freshness (renewal), cleanliness, pores, color uniformity, tone (color), attractiveness, appearance in the morning after sleep and in the evening before bed. The total score was converted into a score ranging from 0 to 100 points. The higher score means that the patient evaluates the quality of the skin higher.

The condition was assessed at the stage of preliminary examination, then after completion of the procedure, after 6 months and after 12 months. The ablative fractional photothermolysis procedure was carried out using a CO<sub>2</sub> laser (in the infrared spectrum with a wavelength of 10.6 μm).

Descriptive statistical methods (mean, standard deviation, frequency, percentage) were used while evaluating the study data. The conformity of the quantitative data to the normal distribution was tested with the Shapiro-Wilk test and graphical examinations. A Student-t test was used for comparisons between two groups of normally distributed quantitative variables, and a Mann-Whitney U test was used for comparisons between two groups of non-normally distributed quantitative variables. Statistical significance was accepted as  $p < 0.05$ .

**Results of the study and their discussion.** After the course, the indicator of satisfaction with skin condition (total score on the FACE-Q Satisfaction with Skin scale) in Group I increased by 42.5 % – from

45.2±13.6 points, at the stage before the procedure to 64.9±12.5 points after completion of procedures ( $p<0.001$ ). After 6 months the score remained significantly higher than the initial level and amounted to 61.3±11.7 points ( $p<0.01$ ), after 12 months it decreased slightly, but was still higher than the average score compared with the primary score (59.1±11.5 points,  $p<0.01$ ).

The similar results were observed in other groups.

In Group II, the score on the FACE-Q Satisfaction with Skin scale increased by 40.7 %—from 39.5±11.8 points before the procedure to 58.9±12.1 points after its completion ( $p<0.01$ ). After 6 months the score was 59.3±11.3 points ( $p<0.01$ ), after 12 months 57.7±11.9 points ( $p<0.01$ ).

In patients of Group III, the score on the FACE-Q Satisfaction with Skin scale increased by 41.7 % – from 41.6±12.7 points before the procedure to 60.9±11.9 points after its completion ( $p<0.01$ ). After 6 months the score was 59.1±12.1 points ( $p<0.01$ ), after 12 months 59.7±12.2 points ( $p<0.01$ ).

A study of the severity of clinical signs of involutive skin changes, as well as their dynamics as a result of treatment, also carried out using VAS, showed that before the procedure of ablative fractional photothermolysis in patients with a deformative morphotype, the overall VAS score was 53.3±2.4 points, after - 21.3±1.3 points (dynamics – 61.5 % ( $p<0.001$ )). After 6 months the score was 21.5±1.8 points ( $p<0.001$ ), after 12 months 19.8±1.9 points, ( $p<0.001$ ).

In patients with finely wrinkled type of aging (Group II), the VAS score before therapy was 52.4±1.9 points, after -20.2±1.8 points, dynamics–60.2 % ( $p<0.001$ ). After 6 months the score was 21.1±1.3 points ( $p<0.001$ ), after 12 months it was 19.7±1.9 points ( $p<0.001$ ).

In patients with a mixed type of aging, the VAS score before therapy was -51.5±1.8 points, after therapy – 18.3 points, dynamics – 65.2 % ( $p<0.001$ ). After 6 months the score was 19.4±1.5 points ( $p<0.001$ ), after 12 months 19.7±1.8 points ( $p<0.001$ ).

Thus, for all morphotypes of aging, significant dynamics are observed after the use of an ablative fractional laser, which indicates the effectiveness of the CO<sub>2</sub> laser system.

When studying the percentage of patients with preserved effect, it was found that after 6 months in the group of patients with deformation morphotype of aging after laser therapy, the number of patients with preserved effect was 93.1 %, in patients with fine-wrinkled morphotype – 95 %, with mixed morphotype of aging – 95.6 %.

With regard to the preservation of the effect after 12 months, the following ratios were obtained: with a deformative morphotype, the number of patients with a preserved effect was 86.2 %, in patients with a finely wrinkled morphotype – 85 %, in patients with a mixed morphotype – 87 %. Thus, long-term observational results confirmed the preservation of the results of using an ablative fractional laser in patients with age-related changes, regardless of the morphotype of aging.

The results we obtained indicate the high efficiency of the fractional CO<sub>2</sub> laser for various types of aging. Previous studies examining the effectiveness of the carbon laser have reported similar results, but the patients involved and the specifics of the technique differed slightly.

Thus, Andrade GB, et al (2023) with the purpose to evaluate the efficacy and safety of CO<sub>2</sub> laser treatments in different patients' skin pathologies studied 705 patients with an age range between 18 and 70 years, with different phototypes according to the Fitzpatrick scale and various diseases (rhinophyma, wrinkles, seborrheic keratosis, papulosa nigra dermatosis, fibropapillomas, sebaceous hyperplasias, etc.) The authors revealed that the use of the CO<sub>2</sub> laser in any phototype and race, provides a safe and effective result for different dermatological pathologies. In our study we did not evaluate skin marks and diseases, only antiaging effect of laser [1].

The other work was performed to compare the efficacy on treatment of static periorbital wrinkles. By the using different emission modes (deep, mid-mode of CO<sub>2</sub> superficial and fusion) of CO<sub>2</sub> fractional laser in 30 patients with static periorbital wrinkles. The patients showed significant improvements on indexes of periocular wrinkles, skin textures, and elasticity at three-month follow-up as compared with baseline ( $p<0.05$ ). Gao L, et al (2022) concluded that fusion mode resulted in better scores of global esthetic improvement scale and patient satisfaction as compared to other modes at both follow-ups. We used only deep mode of CO<sub>2</sub> laser, that was the limitation of our study [5].

Using a rat model of photoaging, Wang H, et al found out that the CO<sub>2</sub> lattice laser increased collagen expression and dermal thickness. The authors showed that in vitro and in vivo data demonstrated high ability of CO<sub>2</sub> laser in reversing the skin aging [13].

A recent report has described the utility of a combined approach of fractional ablative CO<sub>2</sub> with full-field erbium ablation for full face rejuvenation [14].

In our study FACE-Q Satisfaction with Skin scale was used and the patient satisfaction was the main criteria for evaluating the effectiveness. There is considered that a key outcome measure and treatment

goal in aesthetic laser therapy is patient satisfaction. The similar methods were used by Kohl E, et al (2015). They investigated patient expectation and satisfaction using a 14-item questionnaire in 24 female patients and revealed high patient satisfaction with ablative fractional skin resurfacing, also regarding improved self-esteem and self-satisfaction despite high pre-treatment expectations. Skin-specific quality of life had significantly improved [7]. Some authors recommended to assess the clinical effectiveness of the procedures based on the analysis of the validated international global aesthetic improvement scale (Global Aesthetic Improvement Scale; GAIS). On the GAIS scale, results are graded from 5 points, which corresponds to “deterioration in appearance” to 1 point, which corresponds to “marked improvement” [8]. But in our opinion, FACE-Q Satisfaction with Skin scale has more various intervals for evaluating patients satisfaction and allow to assess the results in detail.

The outcomes of CO<sub>2</sub> fractional laser were studied after 6 and 12 months in our patients. Datz E, et al (2018) evaluated the primary outcome parameter after 2, 6, and 12 months after the laser treatment and patient satisfaction with cosmetic results. The authors noted that adaptation of the skin was significantly improved after ablative fractional skin resurfacing. Patient satisfaction with the appearance of the skin was significantly higher after resurfacing. According to results researchers thought that this treatment modality can be recommended for patients wishing to improve the appearance of their skin graft [4].

### Conclusions

1. After the course of CO<sub>2</sub> fractional laser, the total score on the FACE-Q Satisfaction with Skin scale in Group I increased by 42.5 %, in Group II – increased by 40.7 %, in Group III – increased by 41.7 %.
2. In the all groups with different types of aging there were positive dynamics of VAS: 61.5 % (p<0.001) – Group I; 60.2 % (p<0.001) – Group II; 65.2 % (p<0.001) – Group III.
3. It was found that after 6 months in the Group I the percentage of patients with preserved effect was 93.1 %, in Group II – 95 %, in Group III – 95.6 %, after 12 months – 86.2 %, 85 % and 87 %, respectively.

### References

1. Andrade GB, Salguero PM, Fusco I, Galimberti DR. Clinical Evaluation and Experience in Treatments Performed with Fractional CO<sub>2</sub> Laser on Latin American Skin: An Observational Retrospective Study. *Photobiomodul Photomed Laser Surg*. 2023 Jul;41(7):343–349. doi: 10.1089/photob.2023.0015.
2. Chaudhary M, Khan A, Gupta M. Skin Ageing: Pathophysiology and Current Market Treatment Approaches. *Curr Aging Sci*. 2020;13(1):22–30. doi: 10.2174/1567205016666190809161115.
3. Chen KH, Tam KW, Chen IF, Huang SK, Tzeng PC, Wang HJ, et al. A systematic review of comparative studies of CO<sub>2</sub> and erbium:YAG lasers in resurfacing facial rhytides (wrinkles). *J Cosmet Laser Ther*. 2017 Aug;19(4):199–204. doi: 10.1080/14764172.2017.1288261.
4. Datz E, Schönberger C, Zeman F, Koller M, Berneburg M, Landthaler M, et al. Fractional carbon dioxide laser resurfacing of skin grafts: long-term results of a prospective, randomized, split-scar, evaluator-blinded study. *Lasers Surg Med*. 2018 Dec;50(10):1010–1016. doi: 10.1002/lsm.22950.
5. Gao L, Song W, Qian L, Zhang J, Li K, Yang J, et al. Clinical efficacy of different therapeutic modes of CO<sub>2</sub> fractional laser for treatment of static periorcular wrinkles in Asian skin. *J Cosmet Dermatol*. 2022 Mar;21(3):1045–1050. doi: 10.1111/jocd.14640.
6. Husein El Hadmed H, Castillo RF. Cosmeceuticals: peptides, proteins, and growth factors. *J Cosmet Dermatol*. 2016 Dec;15(4):514–519. doi: 10.1111/jocd.12229.
7. Kohl E, Meierhöfer J, Koller M, Zeman F, Groesser L, Karrer S, et al. Fractional carbon dioxide laser resurfacing of rhytides and photoaged skin—a prospective clinical study on patient expectation and satisfaction. *Lasers Surg Med*. 2015 Feb;47(2):111–9. doi: 10.1002/lsm.22326.
8. Kopera D, Palatin M, Bartsch R, Bartsch K, O'Rourke M, Höller S, et al. An open-label uncontrolled, multicenter study for the evaluation of the efficacy and safety of the dermal filler Princess VOLUME in the treatment of nasolabial folds. *Biomed Res Int*. 2015; 2015:195328. doi: 10.1155/2015/195328.
9. Levvitskyi HO, Dudchenko MA, Prykhihdko RA. Evaluation of the quality of the postoperative period and pain syndrome in patients undergoing hemorrhoidectomy by the radiofrequency ablation method. *Current issues of clinical medicine: theses add. All-Ukrainian science and practice conf. of intern doctors, May 23, 2019. Poltava, 2019; 51–52.*
10. Piotrowska A, Bartnik E. The role of reactive oxygen species and mitochondria in aging. *Postepy Biochem*. 2014; 60 (2): 240–7
11. Robati RM, Asadi E. Efficacy and safety of fractional CO<sub>2</sub> laser versus fractional Er:YAG laser in the treatment of facial skin wrinkles. *Lasers Med Sci*. 2017 Feb;32(2):283–289. doi: 10.1007/s10103-016-2111-8.
12. Seoudy WM, El Messallamy HS, Youssef SS, Zaki MSE. Fractional carbon dioxide laser versus combined fractional CO<sub>2</sub> laser and platelet rich plasma in treatment of facial wrinkles: A comparative split face study. *J Cosmet Dermatol*. 2023 Mar;22(3):837–849. doi: 10.1111/jocd.15500.
13. Wang H, Guo B, Hui Q, Lin F, Tao K. CO<sub>2</sub> lattice laser reverses skin aging caused by UVB. *Aging (Albany NY)*. 2020 Apr 20;12(8):7056–7065. doi: 10.18632/aging.103063.
14. Worley B, Cohen JL. Combination Ablative Approach to Laser Therapy in Advanced Aging of the Face. *J Drugs Dermatol*. 2018; 17:796–99.
15. Zhang S, Duan E. Fighting against skin aging: The way from bench to bedside. *Cell Transplant*. 2018;27(5):729–738. doi: 10.1177/0963689717725755.