Open Access Article

MODERN PICOSECOND LASERS FOR PIGMENTATION TREATMENT

Ulugbek Yusupkhanovich Sabirov
Republican Specialized Scientific and Practical Medical Center of Dermatovenerology and Cosmetology, Ministry of Health of Uzbekistan, Tashkent, Uzbekistan

Avaz Shavkatovich Inoyatov
Republican Specialized Scientific and Practical Medical Center of Dermatovenerology and Cosmetology, Ministry of Health of Uzbekistan, Tashkent, Uzbekistan

Bobur Akbarovich Toirov
Republican Specialized Scientific and Practical Medical Center of Dermatovenerology and Cosmetology, Ministry of Health of Uzbekistan, Tashkent, Uzbekistan

Nigora Bakhramovna Khodjaeva
Republican Specialized Scientific and Practical Medical Center of Dermatovenerology and Cosmetology, Ministry of Health of Uzbekistan, Tashkent, Uzbekistan

Elena Vladimirovna Kalendareva
Republican Specialized Scientific and Practical Medical Center of Dermatovenerology and Cosmetology, Ministry of Health of Uzbekistan, Tashkent, Uzbekistan

Marguba Ziyadullaevna Nazarova
Republican Specialized Scientific and Practical Medical Center of Dermatovenerology and Cosmetology, Ministry of Health of Uzbekistan, Tashkent, Uzbekistan

Ilona Igorevna Nazarova
Republican Specialized Scientific and Practical Medical Center of Dermatovenerology and Cosmetology, Ministry of Health of Uzbekistan, Tashkent, Uzbekistan

Elena Valerevna Ligay
Republican Specialized Scientific and Practical Medical Center of Dermatovenerology and Cosmetology, Ministry of Health of Uzbekistan, Tashkent, Uzbekistan

Abstract
At the heart of the development of dermatoses accompanied by a violation of pigmentation is undoubtedly the process of melanogenesis, which is a very complex multistage and difficult-to-

Received: June 16, 2021 / Revised: July 03, 2021 / Accepted: July 31, 2021 / Published: August 17, 2021
About the authors: Ulugbek Yusupkhanovich Sabirov
Corresponding author- Ulugbek Yusupkhanovich Sabirov

regulate. From a molecular genetic point of view, about 280 genes of various proteins, factors of cellular and intercellular interaction, regulating melanogenesis, have been found. Nevertheless, the scientific research of many scientists in recent years has made it possible to deeply advance in understanding the mechanisms of regulation of this process. In particular, the role of medium-wave ultraviolet radiation, predominantly spectrum B (UVB), on human skin, and the mechanisms of its biophotonics have been established. Ultraviolet B triggers cascades of reactions not only in melanocytes, but also in keratinocytes, which are predominantly more abundant in the epidermis and fibroblasts, which form the basis of dermal structures. Thus, these three groups of cells under the influence of excess UV radiation begin to stimulate the production and transport of melanin in the melanosomes into the keratinocyte cells in order to prevent damage to nuclear DNA. Melanin absorbs UV radiation very well and is a chromophore, thus protecting the skin from damage.

Keywords: laser, melasma, chloasma, hyperpigmentation, picosecond laser (PSL), PicoWay, Zoom, Resolve.

摘要

伴随色素沉着破坏的皮肤病发展的核心无疑是黑色素生成过程，这是一个非常复杂的多阶段且难以调节的过程。从分子遗传学的角度来看，已经发现了约280**个各种蛋白**质、细胞和细胞间相互作用因子、调节黑色素生成的基因。尽管如此，近年来许多科学家的科学研究使得深入了解这一过程的调控机制成为可能。特别是，中波紫外线辐射，主要是光谱 B (UVB)，对人体皮肤的作用及其生物光子学机制已经确立。紫外线 B **不**仅在黑素细胞中触发级联反应，还在角质形成细胞中触发级联反应，这些细胞主要在表皮和成纤维细胞中更为丰富，它们构成了真皮结构的基础。因此，这三组细胞在过量紫外线辐射的影响下开始刺激黑色素体中黑色素的产生和转运到角质形成细胞中，以防止对核 DNA **的**损伤。黑色素很好地吸收紫外线辐射，是一种生色团，从而保护皮肤免受伤害。

关键词：激光、黄褐斑、黄褐斑、色素沉着过度、皮秒激光 (PSL)、PicoWay、变焦、Resolve。

Introduction

Currently, one of the urgent problems of dermatocosmetology is skin diseases, accompanied by a violation of pigmentation and skin color, resulting from dysfunction of melanin formation. Melasma and chloasma in particular are one of the most common diseases among all patients with skin dyschromias up to 41% according to foreign literature. Moreover, women of reproductive age are most susceptible to this disease, as well as pregnant women, mainly in the 3rd trimester. Also, foreign authors point to the dependence of skin type in the development of melasma, mainly types III-V according to Fitzpatrick [1, 2, 3, 4]. Since the most significant provoking factor is ultraviolet radiation, in the world literature, the most susceptible population groups are noted, such as: East Asian, Central Asian, Latin American and Spanish, as well as Mediterranean African

groups. These data also indicate the territorial prevalence of melasma. Due to the fact that the population of Uzbekistan lives in conditions of increased insolation and exposure to ultraviolet radiation, and the development of this disease affects the quality of life of patients and is accompanied by psychological experiences, which makes this problem the most urgent and its solution, due to its low level of knowledge, is of great scientific and practical interest [5, 6].

At the heart of the development of dermatoses accompanied by a violation of pigmentation is undoubtedly the process of melanogenesis, which is a very complex multistage and difficult-to-regulate. From a molecular genetic point of view, about 280 genes of various proteins, factors of cellular and intercellular interaction, regulating melanogenesis, have been found. Nevertheless, the scientific research of many scientists in recent years has made it possible to deeply advance in understanding the mechanisms of regulation of this process. In particular, the role of medium-wave ultraviolet radiation, predominantly spectrum B (UVB), on human skin, and the mechanisms of its biophotonics have been established. Ultraviolet B triggers cascades of reactions not only in melanocytes, but also in keratinocytes, which are predominantly more abundant in the epidermis and fibroblasts, which form the basis of dermal structures. Thus, these three groups of cells under the influence of excess UV radiation begin to stimulate the production and transport of melanin in the melanosomes into the keratinocyte cells in order to prevent damage to nuclear DNA. Melanin absorbs UV radiation very well and is a chromophore, thus protecting the skin from damage [7, 8, 9].

A promising direction of modern dermatocosmetology is the development of new technologies aimed at eliminating skin defects in dermatoses accompanied by a violation of melanogenesis, in particular hyperchromia. These diseases include: Melasma, chloasma, post-inflammatory hyperpigmentation [10]. Each of these diseases is manifested by r-perpigmentation, telangiectasias in visible areas of the skin. Such a clinical picture of the disease, mainly affecting the person, brings patients not only suffering, but also reduces the quality of life. The therapy currently used for hyperchromic dermatoses does not always satisfy both patients and dermatologists. The pathological process often recurs [11, 12, 13].

Based on the above, the development of a new method of etiopathogenetic therapy in patients with melasma / chloasma, post-inflammatory hyperpigmentation is very important.

Materials And Methods

We carried out therapy in 51 patients with pathologies such as melasma, chloasma and post-inflammatory hyperpigmentation.

The therapy was carried out once every three weeks for 6-7 months.

The majority of patients -46 (90%) received therapy without side effects. Some patients -5 (10%) felt light-headedness and headaches after the procedure. But all side effects were stopped within 5-10 minutes, without drugs.

Improvement of the process, lightening of hyperpigmented spots and improvement of the quality of the skin took place in 3-4 procedures.

Results And Discussion

Several treatments are available, from topical therapies to chemical peels and lasers. The advent of ultrashort pulsed picosecond lasers (PSL) has transformed the treatment of tattoos and benign pigmented lesions. The PicoWay laser from Candela is a 3-wavelength picosecond laser with high peak power. Picosecond lasers have been around for less than 10 years and are characterized by the ability to generate extremely short pulses in the picosecond range. This means that the light exiting a laser, once pulsed, will travel at a speed of nearly 1 trillionth of a second. This speed will cause some "shock waves" in the target tissue, which will result in mechanical destruction of the target without the need to generate large amounts of heat. The targets are ink particles in the tattoo and small melanosomes that contain the pigment melanin. Thus, the PicoWay laser is the best choice for the treatment of tattoos (both amateur and professional) and all pigmentation problems, including melasma, hyperpigmentation, post-inflammatory hyperpigmentation, Ota nevus and many other conditions. The three wavelengths include 532 nm, which are used for red, orange and purple tattoos, as well as superficial pigmentation called "epidermal". The 785 nm wavelength in the PicoWay laser is used for green and blue tattoos, while the 1064 nm wavelength is used for black tattoos or deeper pigmentation, often referred to as "dermal" [14, 15, 16].

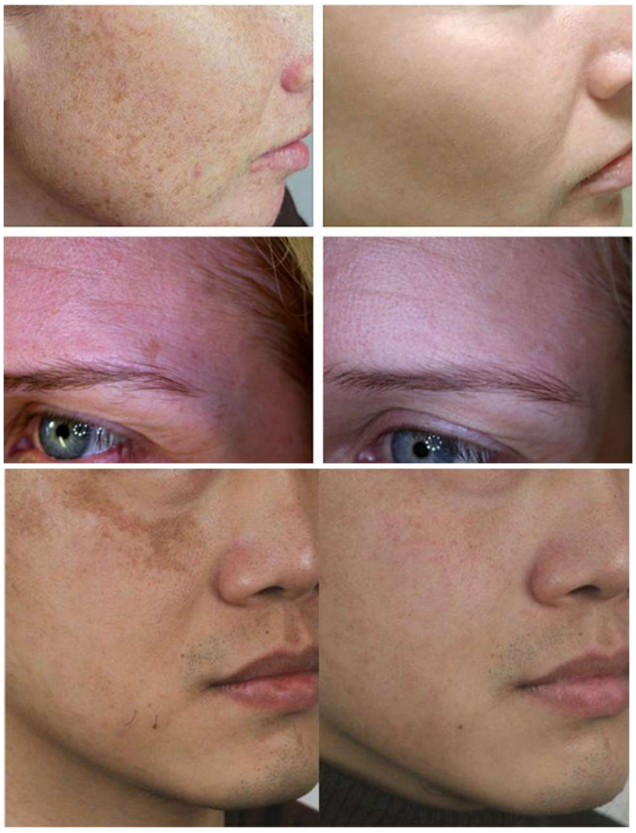
The PicoWay laser also has a special fractional tip called the Resolve tip. It is a unique fractional handpiece with two wavelengths: 532 and 1064 nm. It creates a very complex microscopic injury in the skin called "light-induced optical breakdown" that triggers a cascade of wound healing pathways that ultimately leads to smoother skin, even tone and better collagen [17, 18]. Therefore, Resolve PicoWay laser tips are used in the treatment of acne scars, enlarged pores, uneven tone and pigmentation, stretch marks, dull skin and general facial rejuvenation. PicoWay laser treatments are painless and fast given the ability to use speeds of up to 10 Hz per second, which means any treatment will take anywhere from 5 minutes to half an hour at most, depending on the condition.

Unlike long-pulse lasers (millisecond and microsecond) and Q-switch lasers (nanosecond lasers), PSL delivers very short pulses of one trillionth of a second (range), which is predominantly photomechanical rather than photothermal. This, in turn, improved tissue safety with fewer complications, especially for higher Fitzpatrick skin types. There are several PSLs with different pulse widths and wavelengths. We used two new Candela PSL tips called Picoway. The Picoway system is a PSL with six handpieces covering four wavelengths (532, 730, 785 and 1064 nm). Non-fractional tips are called Zoom (532 and 1064 nm) or Full Beam (730 and 785 nm), fractional tips are called Resolve (532 and 1064 nm).

In 35 (68%) patients, dermatoscopic examination revealed an improvement in the quality of the skin, a decrease in mimic wrinkles for 2-3 treatment procedures. Reduction of hyperpigmented spots by 2-3 procedures.

In 47 (92%) patients, complete recovery occurred at 6-7 months.

Figure 1. Results before and after the picowave treatment



Conclusion

Laser treatment of benign pigmented lesions requires the selection of the correct wavelength and parameters to provide high clinical clearance with low complication rates, especially for higher skin types. This wavelength (1064 nm) is unique in that it is highly absorbed by melanin with very low hemoglobin uptake. It also has the shortest pulse width of any PSL wavelength. This is important because it is shorter than the stress relaxation time of the melanosomes, resulting in a predominantly photomechanical method of pigment removal with little collateral damage.

Resolve Fusion 532nm provides a set of microbeams that combine a high energy density center beam and a low energy density peripheral rim to provide more coverage in a single pass with less exposure to the center beam, resulting in fewer side effects such as petechiae on more high skin types. This fractionated beam produces a distinct microscopic damage called light-induced optical degradation, signaling the cells to rejuvenate and mechanically disrupting melanosomes, resulting in improved clearance of diffuse pigmentation with minimal healing time.

References

1. Rahman Z, Alam M, Dover JS. Fractional Laser treatment for pigmentation and texture improvement. Skin therapy letter. 2006 Nov 1;11(9):7-11.

2. Esen E, Haytac MC, Öz İA, Erdoğan Ö, Karsli ED. Gingival melanin pigmentation and its treatment with the CO2 laser. Oral Surgery, Oral Medicine, Oral Pathology, Oral Radiology, and Endodontology. 2004 Nov 1;98(5):522-7.

3. Berk G, Atici K, Berk N. Treatment of gingival pigmentation with Er, Cr: YSGG laser. Journal of Oral Laser Applications. 2005 Sep 1;5(4).

4. Kaya GŞ, Yavuz GY, Sümbüllü MA, Dayı E. A comparison of diode laser and Er: YAG lasers in the treatment of gingival melanin pigmentation. Oral surgery, oral medicine, oral pathology and oral radiology. 2012 Mar 1;113(3):293-9.

5. Ashinoff R, Levine VJ, Soter NA. Allergic reactions to tattoo pigment after laser treatment. Dermatologic surgery. 1995 Apr;21(4):291-4.

6. Lin TY, Dierickx CC, Campos VB, Farinelli WA, Rosenthal J, Anderson RR. Reduction of regrowing hair shaft size and pigmentation after ruby and diode laser treatment. Archives of dermatological research. 2000 Feb;292(2):60-7.

7. Yannuzzi LA, Slakter JS, Kaufman SR, Gupta K. Laser treatment of diffuse retinal pigment epitheliopathy. European journal of ophthalmology. 1992 Jul;2(3):103-14.

8. Green D, Friedman KJ. Treatment of minocycline-induced cutaneous pigmentation with the Q-switched Alexandrite laser and a review of the literature. Journal of the American Academy of Dermatology. 2001 Feb 1;44(2):342-7.
9. Collins P, Cotterill JA. Minocycline-induced pigmentation resolves after treatment with the Q-switched ruby laser. British Journal of Dermatology. 1996 Aug 1;135(2):317-9.
10. Kawashima Y, Aoki A, Ishii S, Watanabe H, Ishikawa I. Er: YAG laser treatment of gingival melanin pigmentation. InInternational Congress Series 2003 May 1 (Vol. 1248, pp. 245-248). Elsevier.
11. Prasad D, Sunil S, Mishra R. Treatment of gingival pigmentation: A case series. Indian Journal of Dental Research. 2005 Oct 1;16(4):171.
12. Brauer JA, Reddy KK, Anolik R, Weiss ET, Karen JK, Hale EK, Brightman LA, Bernstein L, Geronemus RG. Successful and rapid treatment of blue and green tattoo pigment with a novel picosecond laser. Archives of dermatology. 2012 Jul 1;148(7):820-3.
13. Plensdorf S, Martinez J. Common pigmentation disorders. American family physician. 2009 Jan 15;79(2):109-16.
14. Karrer S, Hohenleutner U, Szeimies RM, Landthaler M, Hruza GJ. Amiodarone-induced pigmentation resolves after treatment with the Q-switched ruby laser. Archives of dermatology. 1999 Mar 1;135(3):251-3.
15. Fitzpatrick RE, Lupton JR. Successful treatment of treatment-resistant laser-induced pigment darkening of a cosmetic tattoo. Lasers in Surgery and Medicine: The Official Journal of the American Society for Laser Medicine and Surgery. 2000;27(4):358-61.
16. Atkin DH, Fitzpatrick RE. Laser treatment of imipramine-induced hyperpigmentation. Journal of the American Academy of Dermatology. 2000 Jul 1;43(1):77-80.
17. Ergun S, Saruhanoğlu A, Migliari DA, Maden I, Tanyeri H. Refractory pigmentation associated with Laugier-Hunziker syndrome following Er: YAG laser treatment. Case reports in dentistry. 2013 Dec 3;2013.
18. Watanabe S. Basics of laser application to dermatology. Archives of dermatological research. 2008 Apr 1;300(1):21-30.