LASER TREATMENT OF ACQUIRED FORMS OF LENTIGO

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Abstract

Lentigo is one of the most frequent causes of visiting a dermatologist. Laser therapy is a modern treatment of acquired forms of this disease, and the article presents the advantages of laser treatment. The practical aspects and clinical examples have been given and reviewed. Choosing an adequate method of laser treatment and an individual approach to a patient when determining the required number of procedures makes it possible to obtain the desired cosmetic effect.

Keywords:

lentigo,
laser treatment of lentigo.

1. Clinical manifestations

Lentigo is caused by local melanin skin hyperchromatism, and it is characterized by the appearance of small flat hyperpigmented spots with 0.5–1.5 cm in diameter. The color ranges from yellow-brown to brown-black, hyperpigmentation foci/areas can be single and/or multiple, located on any skin area and mucous membranes. Lentigines can be congenital or acquired (1-4).

According to the common nosology, there are different clinical diseases/presentation forms:

- Lentigo simplex
- Solar lentigo
- PUVA lentigo
- Speckled lentiginous nevus
- Perigenital-axillary lentiginosis
- Generalized lentigo
- Lentiginous syndromes (1, 2)

Lentigo simplex (juvenile lentigo) is the most common form of the disease, manifested immediately after birth or in early childhood. So far, studies have failed to demonstrate a connection between lentigo simplex and exposure to sunlight or systemic diseases.

Clinical manifestations: Single or multiple hyperpigmented oval or round spots, 3–15 mm in diameter, with toothed or smooth edges. The pigment is spread uniformly within the elements making them brown or black, with various localizations. The histological picture is characterized by elongation of epidermal outgrowths, increased number of melanocytes in the basal layer of the epidermis, increased melanin content in melanocytes and adjacent keratinocytes. The lymphohistiocytic infiltrates of varying density with melanophage admixture are found in the underlying dermis (1, 2, 4).

Solar lentigo (actinic lentigo, senile lentigo, liver spots) is a result of exposure to sunlight (1-3).

Solar lentigo is common for middle-aged people. The prevalence among fair-skinned individuals over 60 years old reaches 90%, while for patients under 35 it is 20%.

Solar lentigines tend to become more frequent in younger populations, aged between 20 and 30 years old, due to frequent use of tanning bads and longer sun exposure habits (1, 4). According to a number of epidemiological studies, the prevalence of this pathology among the Asian nations is higher compared to European nations (5, 6).

The pathogenesis of this form of the disease is based on the following processes: the ultraviolet radiation impacts biologically active molecules which produce the keratinocytes of the epidermis and the fibroblasts of the dermis (endothelin-1, stem cell factor, hepatocyte growth factor and keratinocyte growth factor), which in turn stimulate the proliferation and differentiation of melanocytes from the stem cells and fibroblasts. The sunlight also produces damage of the cellular DNA and activation of the aryl hydrocarbon receptors (7, 8). In addition, it is suggested that environmental factors (NO_2 and other products), when pene-

Cite this article:
Natalia Vladimirovna Volkova, Natalia Gennadievna Kalashnikova, Anna Alexandrovna Tyurina. Laser treatment of acquired forms of lentigo. RoJCED 2017;1(4):20-25.

trating through the skin, can promote lentigo development (9).

Clinical manifestations: Persistant small spots varying from light brown to black, increasing in color intensity and size, which can merge forming large foci (1, 2) located on the lips, back, shoulders, the back of hands.

Histologically, solar lentigines are characterized by hyperkeratosis, elongation of interpapillary epithelial outgrowths in the form of drum sticks consisting of significantly pigmented basaloid cells interspersed with melanocytes. The number of melanocytes is slightly increased (1, 2).

PUVA-induced lentigo affects 1,5–4% of patients receiving long-term treatment with long-wavelength ultraviolet rays.

Clinical manifestations: Dark brown spots with indistinct borders (similar to ephelide borders), usually generalized, including palms and soles, persisting up to six months or longer after the initiation of PUVA therapy for psoriasis (1, 4).

Histologically it is characterized by hypertrophy and hyperplasia of the melanocytes; in some cases cellular atypia is detected (1).

Other rare varieties of lentigo include:

- **Perigenital-axillary lentigo** located in areas with apocrine secretion, occurs sporadically;
- **Generalized lentiginosis** is characterized by multiple lesions that are not associated with systemic disorders, manifested at birth or during the first years of life; it can be inherited in a dominantly pattern;
- **Lentiginous syndromes** include centrofacial lentiginosis, Peutz-Jeghers-Touraine and Soto syndromes, LEOPARD syndrome, lentiginosis with nystagmus and strabismus, etc. Lentiginous syndromes are hereditary and accompanied by systemic lesions of various organs (1).

Lentigo diagnosis is established based on characteristic clinical findings. A differential diagnosis distinguishes lentigo from ephelides, senile keratosis, lentigo maligna melanoma (1, 3, 4). If a congenital lentiginous syndrome is suspected, interdisciplinary consultations are required (physician, neurologist, geneticist, etc.).

Modern methods of acquired lentigo treatment are essentially designed to the destruction of cells containing large amounts of melanin and suppression of excessive melanogenesis. Medical devices (cryotherapy, laser methods), drugs for external use containing hydroquinone, azelaic acid, and retinoids as well as chemical peels, "mesotherapy bleaching cocktails", are currently widely used. It is very important to apply sunscreen during sun exposure to reduce the risk of lentigo recurrence or progression (2, 8, 9).

2. Laser methods of lentigo treatment

Laser methods have taken the lead in treating skin hyperpigmentations of nonneoplastic origin in the last decade and they are preferred procedures when dealing with the local forms of this nosology, including acquired lentigines. Melanin, as a chromophore for the laser radiation, is able to absorb light waves in a wide spectral range. High absorptive capacity of melanin is observed in the ultraviolet (351–400 nm) and visible (400–760 nm) spectral ranges. The absorption capacity decreases with increasing wavelength. Melanin light absorption decreases in the near-infrared spectral range, from 900 nm.

Various types of lasers are applied to treat hyperpigmentations of nonneoplastic origin:

- Pulsed dye laser (595 nm)
- Long-pulse diode laser (810 nm)
- Nd: YAG/Q-switch (1064 nm) with doubled frequency
- Ruby Q-switch (694 nm)
- Long-pulse Alex (755 nm)
- Alex Q-switch (755 nm), etc. (10-14)

The main side effects of hyperpigmentation laser treatment are:

- Thermal damage
- Burns
- Scarring
- Hypopigmentation

Long-pulse laser systems

When applying long-pulse laser systems, the exposure time is much longer than the melanin thermal relaxation time (about 1 μs). As a result, melanin absorbing laser pulse heats up and begins to give up energy intensively to the surrounding tissues. The resulting heat wave is evenly spread from the melanin granules in all directions. The longer the exposure time, the greater the zone of thermal damage of the surrounding tissues. In the case of epidermal hyperpigmentation treatment, it can lead to surface burns without scarring. If the pulse duration is increased, the heating will affect the deeper layers of skin and, in the case of hyperpigmentation in the dermal layer, there will be a high risk of scar complications (10, 13).

Short-pulse Q-switch lasers

Hyperpigmentation treatment using short-pulse Q-switch lasers is based on the effect of generating acoustic waves capable to mechanically destroy the cells with high melanin content. Unfortunately, there are no methods of controlling the adequate energy density level, so the treatment is performed until significant frosting appears. Therefore, both cells with high melanin content and all the surrounding tissues are mechanically destroyed. Such exposure can result in the development of wound surfaces and later in hypopigmentation and scarring (10, 13).

Q-switch lasers with packets of nanosecond pulses (Multiline method)

This technology is exclusive patented as "spot coagulation" method and characterized by selective effect on the excess pigment in the tissues (10, 14). The "spot coagulation" method is implemented in Multiline device using two types of laser emitters:

- Ruby Q-switch (694 nm, 3 mm, 6 mm)

• Alexandrite Q-switch (755 nm, 3 mm, 6 mm)

Laser radiation is applied in the form of wave trains ("packets") of nanosecond pulses. When melanin grain is exposed to the wave train's first pulse, it receives some energy and warms up. Due to short thermal relaxation time (1 μs), melanin grain rapidly cools down and transfers heat to the surrounding tissues after laser exposure. But heat outflow from melanin grain is uneven in different directions.

Collision of thermal waves coming from the adjacent melanin grains occurs in the areas with higher pigment concentration; therefore, the temperature in these areas is higher than in the surrounding tissues with normal pigmentation. When melanin absorbs the following laser wave train pulse in the hyperpigmented spot, the areas between the melanin grains fail to cool down to the initial temperature. So, heating of these areas starts with higher temperature by the next wave train pulse. Consequently, while wave train pulses keep coming, the temperature locally increases step by step to the coagulation level.

In the areas with normal pigment concentration, thermal waves do not collide because of large distances between melanin grains. As a result, the temperature of these areas after each pulse is lower and they manage to cool down to the initial temperature within the interpulse interval. So, the surrounding tissues do not experience a significant thermal exposure because no heat is gradually accumulated in them. The spot coagulation effect is manifested in the hyperpigmented spot only where melanin concentration is excessive.

This method can be used for coagulating melanin on the entire depth of the pigment occurrence in the skin, which reduces the number of procedures. No significant thermal damage of the surrounding tissues or acoustic damage of hyperpigmented areas are observed, which makes this method safe (10, 11, 14, 15).

We further present our own clinical observations of the solar lentigines treatment using the Q-switch method with packets of nanosecond pulses (Ruby Q-switch 694 nm, 3 mm and emitter Alex Q-switch 755 nm, 3 mm).

3. Case presentation

Clinical case 1

Female patient R.L., 32 years old. The patient had complained about a pigmented spot on her right cheek.

Anamnesis: The element appeared a few years ago, the patient cannot specify the reasons. She did not visit a dermatologist before.

Status: The skin process is localized, represented by irregularly shaped brown spot with clear borders on the right cheek skin. The element surface is 3 cm^2 (Figure 1A).

Diagnosis: Solar lentigo.

Treatment: Single laser pigment removal was performed using (Multiline device) Ruby Q-switch laser (694 nm, 3 mm) at frequency 2 Hz, energy density 20.5 J/cm^2.

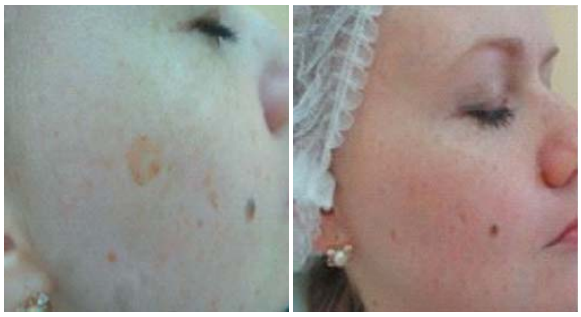

Figure 1. Female patient R.L. Before (A) and after (B) treatment

Result: Examination after two weeks – almost complete regression of the pigmented spot (Figure 1B).

Clinical case 2

Female patient K.M., 58 years old. The patient had complaints of pigmentation on the nasal wing.

Anamnesis: The spot of a rice grain size first appeared approximately 10 years ago. The patient does not know what could be the reason for the disease. The pigmented lesion began to increase in size four years ago, when menopause occurred.

Status: The bright brown spot with clear borders is visible on the nasal dorsum skin. The element is uniformly colored. The surface is 2 cm^2 (Figure 2A).

Diagnosis: Solar lentigo.

Treatment: Seven laser pigment removal procedures were performed using (Multiline device) Alex Q-switch laser (755 nm, 3 mm) at frequency 3 Hz, energy density 25 J/cm^2. The interval between the procedures was 2–3 weeks.

Result: Complete regression of the element (Figure 2 B).

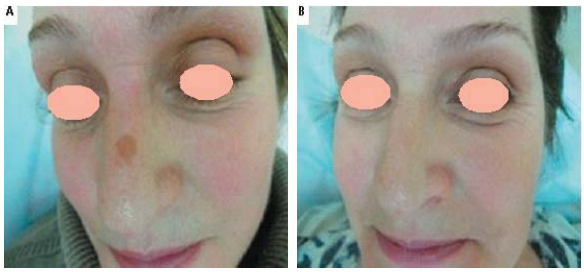

Figure 2. Female patient K.M. Before (A) and after (B) treatment

Clinical example 3

Female patient Sh.P., 35 years old. The patient had complaints of/ about the brown spot on the right eyebrow skin.

Anamnesis: The spot first appeared two years ago. The patient thinks it was caused by multiple visits to the tanning salon. She has not visited a dermatologist before.

Status: The brown round spot with clear borders is visible on the right eyebrow skin, its coloring is slightly uneven. The element surface area is 1 cm^2 (Figure 3A).

Diagnosis: Solar lentigo.

Treatment: Two laser pigment removal procedures were performed using (Multiline device) Alex

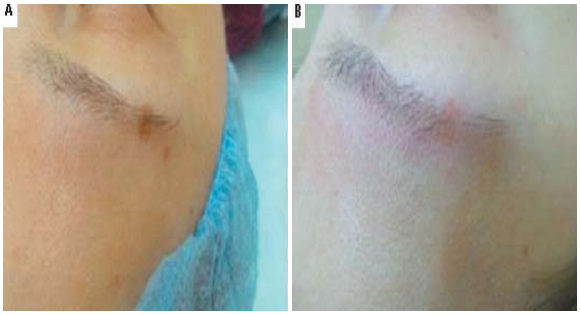

Figure 3. Female patient Sh.P. Before (A) and after (B) treatment

Q-switch laser (755 nm, 3 mm) at frequency 3 Hz, energy density 17 J/cm^2. The interval between the procedures was two weeks.

Result: Examination three weeks later after the second procedure revealed that the pigment spot was pale with indistinct borders (Figure 3B). The eyebrow growth and the hair were not changed, which demonstrated a high degree of selectivity of Alex Q-switch laser radiation (Multiline device) on the pigment in the spot without affecting the surrounding tissues in the treatment area. The spot appearance did not trouble the patient, so she discontinued the treatment.

Clinical example 4

Female patient S.N., 51 years old. The patient had complaints of/about the spot on the left cheek.

Anamnesis: The spot first appeared three years ago for no apparent cause. She used depigmenting cosmetics from the pharmacy at home without effect.

Status: The skin process is localized. The pigmented rounded spot is on the left cheek skin. It is light-brown with uneven coloring, hyperpigmentation in the central part of the spot is missing. The borders are clear. The element surface area is 4 cm^2 (Figure 4A).

Diagnosis: Solar lentigo.

Treatment: Four laser pigment removal procedures were performed using (Multiline device) Alex Q-sw laser (755 nm, 3 mm) at frequency 3 Hz, energy density 25 J/cm^2. The interval between the procedures was 2–3 weeks.

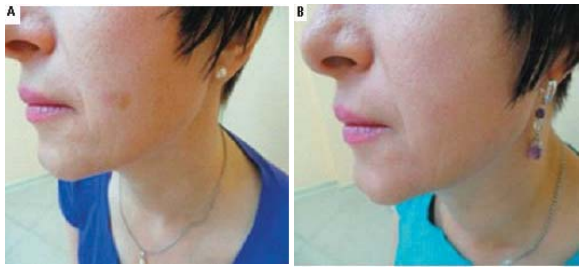

Figure 4. Female patient S.N. Before (A) and after (B) treatmement

Result: Almost complete regression of the element was achieved after four treatments. The residual effects are identified as a faint, ill-defined hyperpigmented area with indistinct borders (Figure 4 B).

4. Conclusion

The presented clinical cases demonstrate high effectiveness and safety of the "spot coagulation" laser method (with packets of nanosecond pulses realized in Q-sw regimen) for the treatment of solar lentigines. Two types of emitters, Ruby Q-sw (694 nm) and Alex Q-sw (755 nm), have been used. The number of procedures in the hyperpigmentation treatment course is determined individually. The uniqueness of the "spot coagulation" method is based on a high selectivity of the exposure, causing no damage to the surrounding tissues and not affecting hair growth in the treatment area. Pigment removal using this method can be carried out year-round, including spring and summer.

Financial disclosure: none declared.
Patient consent: All patients consented to give the clinical data and photos for publication in this article.
Conflicts of interest: none declared.

Bibliography

1. Elkin VD, Mitryukovsky LS, Sedova TG. Elected dermatology. Rare Dermatoses and Dermatological Syndromes. *Perm* 2004.
2. Vivier A. *Atlas of Clinical Dermatology*. Elsevier, 2013.
3. White GM, Cox NH. *Diseases of the skin. A Color Atlas and text*. Second Edition. Philadelphia, Elsevier, 2006.
4. Electronic source: http://cosmepedia.info/cosmepedia/lentigines
5. Nouveau-Richard S, Yang Z, Mac-Mary S, Li L, Bastien P, Tardy I, Bouillon C, Humbert P, de Lacharrière O. Skin ageing: a comparison between Chinese and European populations. A pilot study. *J Dermatol Sci* 2005;3:187-193.
6. Perner D, Vierkötter A, Sugiri D, Matsui M, Ranft U, Esser C. Association between sun-exposure, smoking behavior and plasma antioxidant levels with the different manifestation of skin ageing signs between Japanese and German women – a pilot study. *J Dermatol Sci* 2011;2:136-140.
7. Berneburg M, Plettenberg H, Medve-König K, Pfahlberg A, Gers-Barlag H, Gefeller O, Krutmann J. Induction of the photoaging-associated mitochondrial common deletion in vivo in normal human skin. *J Invest Dermatol* 2004;5:1277-1283.
8. Jux B, Kadow S, Luecke S, Rannug A, Krutmann J, Esser C. The aryl hydrocarbon receptor mediates UVB radiation-induced skin tanning. *J Invest Dermatol* 2011;1:203-210.
9. Hüls A, Vierkötter A, Gao W, Krämer U, Yang Y, Ding A, et al. Traffic-Related Air Pollution Contributes to Development of Facial Lentigines: Further Epidemiological Evidence from Caucasians and Asians. *J Invest Dermatol* 2016;5:1053-1036.
10. Khomchenko VV, Pozdeeva EV, Urakova DS, et al. *Study Guide on Using Multifunctional Laser Device Multiline in Aesthetic Medicine*. Moscow, 2013.
11. Kalashnikova NG. Laser Correction of Acquired Hyperpigmentation in Connection with Couperosis: Examples from Practice. *Device-based Cosmetology and Physiotherapy* 2010;2:32-37.
12. Shepty OV. Basic Principles and Biological Mechanisms of Laser Radiation Effects on Skin. *Lasers and Aesthetics* 2012;(3)1.
13. Seirafi H, Fateh S, Farnaghi F, Ehsani AH. Noormohammadpour P. Efficacy and safety of long-pulse pulsed dye laser delivered with compression versus cryotheorapy for treatment of solar lentigines. *Indian J Dermatol* 2011;1:48-51.
14. Khomchenko VV, Kotaev GG. Method of Therapeutic Intervention on Pigmented Lesions and Tattoos. *Patent of invention* No. 209605.
15. Khomchenko VV. Using High-Energy Lasers in Cosmetology. *Bulletin of Aesthetic Medicine* 2010;2:6-11.