

NONABLATIVE LASER TREATMENTS AS AN ALTERNATIVE TO ABLATIVE LASER PROCEDURE

НЕАБЛАТИВНІ ЛАЗЕРНІ ЛІКУВАННЯ ЯК АЛЬТЕРНАТИВА АБЛАТИВНОЇ ЛАЗЕРНОЇ ПРОЦЕДУРИ

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Summary

Nowadays, we have various ways to check if new collagen was formed. One of such researches used this method to check effects of non-ablative laser treatments. Laser treatments have been one of the best methods of skin remodeling since they were introduced into aesthetic medicine and cosmetology. Numerous patients on the whole world benefit from this kind of face rejuvenation. However, lasers, when we speak about skin rejuvenation, have their bad effects. One of them is definitely healing process and the second one is possible damage to skin because of ablation. Recent techniques, non-ablative laser treatments, definitely take away the two drawbacks mentioned before – except skin ablation; there is less healing time and less probability of permanent damage to skin. However, is this enough to have also very good effects? Is it possible without proper damage to have very good results? This paper will investigate this matter on the basis of opinions of doctors and biophysics experts in the field of aesthetic medicine and cosmetology. All in all, the non-ablative laser devices, together with skin-cooling device, are proven to be safe and effective for skin rejuvenation in patients regardless their nationality. The advantages of such techniques for wrinkle reduction include the easiness of performance, lack of patient discomfort and treating all skin types without the high risk of epidermal injury. Non-ablative resurfacing techniques are very well suited for patients who need rejuvenation for their aging face. No matter what laser type is introduced, when speaking of non-ablative procedures, regardless of the fact if wrinkles, fine lines or skin surface is treated, the effects are subtle and gradual, comparing to ablative techniques, which are more aggressive. Various lasers are introduced to identify the best modality; however the extended pulse lasers are seen to provide particular benefits. Both the 1320nm and 1064nm lasers, when co-working with a skin-cooling device, are unique and appropriate for all skin types. Furthermore, these treatments are regarded as safe, and with less downtime for patients.

Keywords: nonablative laser treatments, ablative laser treatments, development, cells, anatomy.

У наш час ми маємо різні способи перевірити, чи не утворився новий колаген. Одне з таких досліджень використовувало цей метод для перевірки ефектів неаблативних лазерних процедур. Лазерні процедури були одними з найкращих методів ремоделювання шкіри з тих пір, як вони були впроваджені в естетичну медицину та косметологію. Багато пацієнтів у всьому світі отримують користь від такого виду омолодження обличчя. Однак, коли ми говоримо про омолодження шкіри, лазери мають свої погані наслідки. Один з них – це безумовно процес загоєння, а другий – можливе пошкодження шкіри через абляцію. Останні методи, неаблативні лазерні процедури, безумовно усувають два недоліки, згадані раніше – крім абляції шкіри; менше часу загоєння та менша ймовірність постійного пошкодження шкіри. Однак чи достатньо цього, щоб мати також дуже хороші ефекти? Чи можливо без належної шкоди отримати дуже хороші результати? Ця стаття буде досліджувати це питання на основі думок лікарів та фахівців з біофізики у галузі естетичної медицини та косметології. Загалом, неаблативні лазерні прилади разом із приладом для охолодження шкіри є надійними та ефективними для омолодження шкіри у пацієнтів, незалежно від їх національності. Переваги таких методів зменшення зморшок включають простоту виконання, відсутність дискомфорту у пацієнта та лікування всіх типів шкіри без високого ризику пошкодження епідерми. Неаблативні методи шліфування дуже добре підходять для пацієнтів, які потребують омолодження для

старіння обличчя. Незалежно від того, який тип лазера введений, говорячи про неаблативні процедури, незалежно від того, чи обробляються зморшки, дрібні лінії або поверхня шкіри, ефекти є тонкими і поступовими, порівняно з аблятивними техніками, які є більш агресивними. Різні лазери представлені для виявлення найкращої модальності; однак, як видно, розширені імпульсні лазери дають особливі переваги. І 1320 нм, і 1064 нм лазери, коли працюють разом із пристроєм для охолодження шкіри, унікальні та підходять для всіх типів шкіри. Крім того, ці методи лікування вважаються безпечними та мають менший час простою для пацієнтів.

Ключові слова: неаблативне лазерне лікування, абляційне лазерне лікування, розвиток, клітини, анатомія.

В наше время мы имеем различные способы проверить, не образовался ли новый коллаген. Одно из таких исследований использовало этот метод для проверки эффектов неаблативных лазерных процедур. Лазерные процедуры были одними из лучших методов ремоделирования кожи с тех пор, как они были введены в эстетическую медицину и косметологию. Многие пациенты во всем мире получают пользу от такого вида омоложения лица. Однако, когда мы говорим об омоложении кожи, лазеры имеют свои плохие последствия. Один из них – это безусловно процесс заживления, а второй – возможное повреждение кожи через абляцию. Последние методы, неаблативные лазерные процедуры, безусловно устраняют два недостатка, упомянутые ранее – кроме абляции кожи; меньше времени заживления и меньше вероятность постоянного повреждения кожи. Однако достаточно ли этого, чтобы также иметь очень хорошие эффекты? Возможно ли без должного вреда получить очень хорошие результаты? Эта статья будет исследовать этот вопрос на основе мнений врачей и специалистов по биофизике в области эстетической медицины и косметологии. В общем, неаблативные лазерные приборы вместе с прибором для охлаждения кожи являются надежными и эффективными для омоложения кожи у пациентов, независимо от их национальности. Преимущества таких методов уменьшения морщин включают простоту исполнения, отсутствие дискомфорта у пациента и лечение всех типов кожи без высокого риска повреждения эпидермиса. Неаблативные методы шлифовки очень хорошо подходят для пациентов, нуждающихся омоложения для старения лица. Независимо от того, какой тип лазера введен, говоря о неаблативных процедурах, независимо от того, обрабатываются морщины, мелкие линии или поверхность кожи, эффекты являются тонкими и постепенными, по сравнению с аблятивными техниками, которые являются более агрессивными. Различные лазеры представлены для выявления лучшей модальности; однако, по всей видимости, расширенные импульсные лазеры дают особые преимущества. И 1320 нм, и 1064 нм лазеры, когда работают вместе с устройством для охлаждения кожи, уникальные и подходят для всех типов кожи. Кроме того, эти методы лечения считаются безопасными и имеют меньшее время простоя для пациентов.

Ключевые слова: неаблативное лазерное лечение, абляционное лазерное лечение, развитие, клетки, анатомия.

Benefits of non-ablative laser treatments

One of the most reliable reviews of effects is perhaps collagen formation. Nowadays, we have numerous ways to check if new collagen was formed. One of such researches used this method to check effects of non-ablative laser treatments. It shows that collagen remodeling can occur without the need for epidermal ablation. To evaluate treatment effects, six-month posttreatment biopsies were conducted. 10 subjects were treated with a non-ablative 1320 nm Nd:YAG laser. They had five treatments with 3-4 week

intervals, and the results were tested for degree of clinical improvement 6 months after their final treatment. All 10 patients reported significant improvement of the quality of their skin. However, the opinions were very subjective. What medicine and cosmetology field needs is hard evidence. That is why, biopsies were conducted. The six-month posttreatment biopsies showed collagen formation. This is a voice in favor of non-ablative laser methods- full face improvement seems to occur without epidermal ablation [1].

According to experts:

“In non-ablative resurfacing, fractional lasers deliver heat into the skin through thousands of tiny, deep columns known as microthermal treatment zones. The treatment eliminates old epidermal pigmented cells and deposits heat deep into the dermis to tighten skin and stimulate collagen remodeling. Surrounding tissue is unaffected. The fractional approach allows the skin to heal much faster than if the entire area was treated. Healthy tighter skin grows to replace wrinkled skin. This approach lessens the recovery period and reduces the number of complications that can occur. Multiple sessions are needed in some cases” (Goldberg, 2000:59-61).

Laser devices are getting more and more technologically advanced. Overall, the treatment is focused on reduction of rhytides and skin laxity, and this can be a factor in improving overall facial appearance. What is a distinguishing factor between ablative technique and non-ablative one? During an ablative facial resurfacing treatment, the epidermis is denuded by laser wave to a certain depth. The treatment factor is in fact

injury. The ablative cutaneous injury causes the desired healing response, which results in the deposition of a new skin matrix. This new skin matrix has improved characteristics – and this is what we search for in rejuvenation. During the healing process, there is proliferation of fibroblast activity, and a formation of new collagen and other dermal matrix proteins [2].

The procedure of non-ablative treatment should always be according to some schedule:

“During the procedure, the treatment area is first cleansed. Next, a laser head is passed over the treatment area in a series of horizontal and vertical overlapping passes. Most patients experience a mild prickling or burning sensation during the process. In some cases, the doctor will apply a topical anesthetic beforehand, or apply a cooling mechanism during treatment. The procedure typically takes 20 to 25 minutes. The fractional lasers used in non-ablative resurfacing use lower energy levels than ablative lasers, which resurface or remove the outer layer of skin completely. Fractional lasers treat the layers of skin under the surface without damaging the surface. Heat from the laser promotes collagen production, which helps reduce the appearance of lines and wrinkles. The results, however, are less pronounced than the more aggressive approach of ablative laser resurfacing” (Goldberg, 2000:59-61).

Ablative lasers have very good clinical results. However, the downtime caused by the procedure and possible adverse effects can last for several weeks, which is found by most patients unacceptable. The very high potential for really impressive skin improvement must be balanced very well against protracted edema and erythema and pigmentary changes or potential complications like scarring. In fact, the prolonged recovery, typical for such method, together with some potential problems which may occur within these ablative techniques can be a limit, when it comes to patients who want to implement a rejuvenation procedure with a very slight downtime and a minimal risk profile [2].

Goldberg (2000) enumerates the expected results after the procedure:

- “Most patients can return to work immediately after the procedure.
- Redness caused by the treatment can be camouflaged by makeup without any negative effects.
- The treatment area should be kept well moisturized.
- Patients should avoid sleeping on the treatment area to prevent swellings.
- Cold compresses can be applied to alleviate pain.

- Sun exposure should be avoided during treatment and healing phases, and sunscreens of at least SPF 30 should be applied” Goldberg, 2000:60)

In contrast to ablative rejuvenation treatments, non-ablative laser treatments cause a dermal healing response, as was the case with ablative procedures, without notable injury to the epidermis. This is what characterizes non-ablative laser treatments in a good way – improving the appearance of the skin without visible injury to the epidermis [3].

What are the exact mechanisms of non-ablative dermal remodeling? They have not yet been found and are still under investigation; however, researchers do have their picks – subthreshold laser-induced injury to the dermis results in a wound repair response, as they think, and, in turn, this induces fibroblast stimulation and collagen reformation [3].

The benefits of using mid-infrared non-ablative lasers – non-ablative technique in detail

Mid-infrared lasers are the main non-ablative laser rejuvenation modalities. Increased research and increased body of evidence confirms that lasers in the mid-infrared range seem to be the best choice when it comes to non-ablative

resurfacing and a wide range of skin types and colors [4].

Mid-infrared range lasers use energy that is weakly attracted to melanin, which is a good thing, because, when epidermal melanin is bypassed more efficiently, patients with all skin types can be treated, and the risk is reduced. Also, when the wavelength of the selected laser is extended to the infrared and mid-infrared areas, deeper energy penetration can be achieved, and the desired laser energy can finally be transported to the dermis. In this way, the epidermis is bypassed, and the heat laser energy produces is deposited in the dermis in a nonselective way. In theory, the result of such heat-induced dermal injury is eventual activation of dermal fibroblasts and the activation of the desired healing response. Moreover, an inflammatory response to this laser-generated heat cause collagen remodeling and an improvement in the condition of rhytides [4], [5].

When it comes to histologic evidence, early studies demonstrated dermal collagen homogenization, which is the indication of the occurrence of some degree of dermal remodeling. However, it is crucial to note that the use of such techniques without a skin-cooling device produces bad clinical results. What is more, without the cooling, pitted scars and hyperpigmentation occurred in 30-40 % of clinical cases [5].

The endless search for ideal nonsurgical rejuvenation method for the aging face is at the heart of aesthetic medicine and cosmetology, and companies producing equipment outrun each other in that search. However, picking the ideal nonsurgical skin rejuvenation method is dependent on each patient's skin type, rejuvenation goals, recovery time of the patient, possibility of complications, and perhaps the most importantly, esthetic expectations.

The physician's or cosmetologist's experience is crucial when taking all the factors into consideration to decide which treatment should be administered. What is an ideal rejuvenation method? It is the method that improves the condition of skin without causing injury to epidermis [6], [18].

Cases of rhytides in non-ablative laser treatments

The contraction of the frontalis muscle is responsible for the formation of forehead rhytides. When it comes to non-ablative laser treatment techniques in reducing rhytides, it should

be admitted that they are softened by non-ablative procedures, however, muscles are still in action and, if the patient had a rich mimic, sometimes he or she is advised to be treated with botulinum toxin injections after treatment to release the frontalis muscle [7].

History of non-ablative lasers

Mid to late 1990s clinical improvement in the appearance of hypertrophic scars and stretch marks were reported. Minor injuries were treated without significant ablation of the epidermis. Histologic evidence of decreased coarse collagen fibers supported that finding, and increased formation of elastin in biopsy specimens [8].

Both clinical and, most importantly, histologic improvements in the appearance of scars made investigators to evaluate the efficiency of non-ablative skin rejuvenation techniques. In 1999 the researcher named Zelickson noted an improvement in 9 out of 10 patients (which complies 90 % improvement) with mild skin flaws, and an improvement in 4 out of 10 (40 %) patients with moderate and even with severe problems. All of them were treated with a non-ablative laser technique [8], [9].

Histologic observations which correspond to these clinical observations showed an increase in epidermal thickness and new formation of collagen and elastin. Other studies also showed reduction in depigmentation. However, even though there were very appreciable clinical improvements in those cases, early non-ablative techniques caused significant bruising and swelling which lasted up to 2 weeks. Also, the treatment was limited for use in dark-skinned or tanned patients [9].

Review of available devices

When it comes to devices and facilities, many different laser treatments appliances are available but all of them vary in the aspects of energy intensity and delivery as well as injury patterns. What is interesting about laser devices is that, some of them lack papers and peer-reviewed articles to support their treatment effectiveness, and they only rely on clinicians' promotion. The companies that produce laser devices need to perform wide research to shown their effectiveness in published research in medical journals [10], [17].

The first commercial laser device was in fact non-ablative in its original form, had a blue optical guide material, which allowed the device to sense skin contact before starting to work. The

company which produced this device was Solta Medical, and the name of the device was non-ablative Fraxel. The company has high-tech

solutions and also sponsored clinical trials with highly skilled laser surgeons and world-leading devices [11].

DEVICE	COMPANY
Active FX	Lumenis
Slim MIX/SX	Lasering USA
Exelo 2	Quantel
Fraxel re pair (600u hand piece)	Reliant
Juvia	Ellipse
SmartXide	DEKA
Q-Ray (CO ₂ fractional + RF + IR platform)	Dosis M&M
QuadraLase	Candela
Affirm CO ₂	Cynosure

Figure 1. Micro ablative (non-ablative) fractional resurfacing devices <750um

Implementation of treatment

The American FDA norm for the non-ablative devices usually includes its use for the coagulation of soft tissues. What does it mean for a patient? Coagulation of protein causes the formation of new protein tissue, which may result in a deep rejuvenation of the skin [12].

What are the advantages?

The first and the most important benefit from using this type of device is minimal patient discomfort. Some patients may require topical anesthetic and cooling during the procedure, but it is not a must with non-ablative devices (contrary to ablative laser devices). What happens after the treatment is also acceptable – most patients notice only slight redness after treatment in the following day [13].

Clinical studies

However, after mentioning advantages, it is time to look into possible disadvantages, which often come out in a series of clinical reviews. One of the most important clinical studies for non-ablative laser devices is the one made by Manstein (2018), who found great improvements in periorbital lines within one month only and 54 % improvement when it comes to rhytids and skin texture. After three months from the treatment, 34 % improvement was found when it comes to wrinkles treatment and 47 % improvement in skin texture. A different study conducted by

Geronemus (2009) reported that the device improved not only rhytids but also lip lines (vertical ones). However, the researcher noted that the results were not as good as when using ablative laser device. Another study made by Rahman (2009) proved that non-ablative laser device in combination with intense pulsed light (IPL) worked better than the non-ablative laser alone in the 29 patients that they studied. The non-ablative device, as it was expected, stimulated dermal collagen and remodeling. This, in turn, led to improvements in rhytids and skin texture. IPL helped with the results of photo damage, namely dyschromia and telangiectasia. Several publications on clinical studies were also conducted showing the positive effects of treating melasma, acne scars and other scars using the non-ablative laser device, which is in favor of the use of non-ablative laser devices [14].

Another non-ablative device was *Affirm* produced by *Cynosure, Westford, Massachusetts*. It had a slightly different design as it was a 1440nm FT laser in which the energy was delivered through a micro-array of lenses that caused the desired results to the skin. This kind of light delivery which goes through the array of lenses is called apex pulse technology. There were a couple of studies, including the work of Weis (2002). This investigation showed that the *Affirm* laser was effective in the treatment of various skin problems. These include wrinkles, scars, and pigimentary problems including melisma. This laser

received FDA approval for the treatment of wrinkles and pigmented lesions. When it comes to the number of treatments needed, most patients need 3 to 6 treatments with this device. Very small adverse effects occur with patients treated with this laser and if they occur, usually resolve within 24 hours, and most patients do not have any downtime associated with the treatment. What was new with this device? One of the most prominent features is the additive of a second wavelength of light, 1320nm. This is useful for skin tightening. The undoubted advantage is a multiplexed event – both lengths fire during the same pulse of light which make the treatment of wrinkles and scars even more effective. Below Figures 2 to 5 present clinical examples of the usage of Affirm laser with patients after three treatments [16], [19].

The mentioned before two devices – Fraxel and Affirm, are not the only ones, however, these are the devices which usage has been proved by extensive research and clinical studies. All of the lasers work in a similar way. They distribute non-ablative laser energy into the dermis through pixilated columns or through an array of lenses.

What is common for all of such devices is that they work over time, which usually means and more than one treatment needed to achieve the visible effects. It is however hard to determine the exact number of treatments needed to achieve the desirable results. It also depends on the device, its technology and power. However, most of the researchers and laser surgeons assume that, to achieve satisfactory, visible results, four to six treatments are needed. The recommended interval between treatments is up to four weeks. Contrary to what is often presupposed, some slight downtime with non-ablative devices does exist. Most patients experience slight erythema and edema for 24 to 48 hours after procedure. Adverse effects can include post-inflammatory hyperpigmentation, which is more commonly observed with dark skins. Good pretreatment and post treatment therapy and information to the patients could minimize the risk of such PIH condition in the high risk patients [15].



Figure 2. Before treatment



Figure 4. Before treatment



Figure 3. After treatment Figure



Figure 5. After treatment

Conclusion

All in all, the non-ablative laser devices, together with skin-cooling device, are proven to be safe and effective for skin rejuvenation in patients of all skin types and colours. The advantages of such techniques for wrinkle reduction include the easiness of performance, lack of patient discomfort (or a minimal one) and treating all skin types without the high risk of epidermal injury.

Non-ablative resurfacing techniques are very well suited for patients who need rejuvenation for their aging face. No matter what laser type is

introduced, when speaking of non-ablative procedures, regardless of the fact if wrinkles, fine lines or skin surface is treated, the effects are subtle and gradual, comparing to ablative techniques, which are more aggressive. Many different lasers are investigated to identify the best modality; however the extended pulse lasers are seen to provide particular benefits. Both the 1320nm and 1064nm lasers, when co-working with a skin-cooling device, are unique and appropriate for all skin types. What is more, at this time, these treatments are regarded as safe, and with less downtime for patients.

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