http://www.moderntechno.de/index.php/meit/article/view/meit42-02-040
DOI: 10.30890/2567-5273.2025-42-02-040

EFFECTIVENESS AND SAFETY OF LASER HAIR REMOVAL, COMPARISON WITH TRADITIONAL HAIR REMOVAL METHODS

Chernychko Viktoriia
ORCID: https://orcid.org/0009-0004-7999-0592
Sumy State Pedagogical University named after A.S. Makarenka, Ukraine

Abstract. *The article is devoted to the analysis of the effectiveness and safety of laser hair removal in comparison with traditional hair removal methods, such as shaving, waxing, sugaring, the use of depilatory creams and mechanical plucking.* ***The purpose of the study*** *is to establish the level of effectiveness of laser hair removal in relation to traditional hair removal methods and to identify the key risks associated with each of the approaches. During the scientific study, general scientific methods of cognition were used, in particular, analysis, synthesis, comparison, systematization, generalization and classification.* ***The results*** *of the study show that traditional hair removal methods, despite technological progress, remain popular due to their accessibility, versatility and ability to adapt to the individual needs of users. It was established that mechanical and chemical methods (shaving, sugaring, waxing, creams) provide a short-term or medium-term effect without directly affecting the hair follicle. These methods are characterized by varying degrees of pain, the likelihood of ingrown hairs, irritation, folliculitis and other side effects. Depilatory creams deserve special attention, which allow the treatment of large areas of skin, but have a high probability of causing allergic reactions and dermatitis. It has been established that the effectiveness of laser hair removal largely depends on the amount of melanin in the hair structure, which limits the effectiveness of the procedure for blond, red and gray hair. It has been found that short-term side effects in the form of redness and irritation occur in about 10% of cases, but disappear within 1–2 days. Possible long-term risks have also been described - pigmentation disorders, chronic erythema, inflammatory dermatoses, damage to the apocrine glands, changes in the dermis and loss of subcutaneous fat, which requires increased attention to the individual characteristics of the patient and strict adherence to safety protocols. It was concluded that laser hair removal is an effective method with proper selection of the laser type, skin phototype and individual approach to the patient.* ***The practical significance*** *of the study lies in the possibility of optimizing the choice of hair removal method depending on skin type, hair color and expected duration of the effect, taking into account risks.*

Keywords: *laser hair removal, traditional methods, effectiveness, side effects, safety*

Introduction

Although hair removal is a cosmetic procedure, its importance is not limited to aesthetics. If the procedure increases self-confidence, reduces anxiety and improves subjective comfort, this is enough for its justified use. However, there are also medical indications for laser hair removal. These include: hypertrichosis (a condition characterized by excessive hair growth in women and men on any part of the body, accompanied by an increase in the length and thickness of the hair [9]); hirsutism (an endocrine disorder in which women have excessive growth of terminal hair according to the male pattern [8]). Laser hair removal is also an effective method of combating ingrown hair, since the destruction of hair follicles and the slowing of hair growth

reduce the risk of new ingrown hairs and the development of folliculitis. In general, laser hair removal is considered a safe procedure, but there are a number of contraindications that do not allow its use.

However, traditional hair removal methods remain conditionally safe if the rules of their implementation and safety are followed. However, this safety is also described in the literature as “conditionally safe”, and therefore cosmetologists need to consider all risk factors before making a decision about a cosmetic procedure.

This work is of particular value for practicing cosmetologists specializing in hair removal, as it contains generalized and grouped results of the analysis of scientific literature describing the clinical application of laser and non-laser methods of hair removal.

Literature Review

The issue of the effectiveness and safety of laser hair removal, as well as its comparison with traditional methods of hair removal, has been sufficiently studied in foreign scientific literature. The sources presented represent modern international approaches to the study of laser technologies in dermatology, in particular regarding the effectiveness of procedures, side effects and their comparative analysis with other methods of depilation. A significant contribution to the development of the topic was made by authors such as M. Haedersdal [5], who in 2006 laid the scientific basis for assessing the evidentiary effectiveness of laser and light technologies, and M.H. Gold [4], S. Rafi [8] and G. Cannarozzo [3], M. Atta-Motte and I. Załęska [1], who drew attention to the peculiarities of reactions to laser hair removal. Review articles by Bonan P. [2] and Saleh D. [9] form a contextual vision of modern trends in the field of hair removal. S.P. Nistico [7] and M.M. Thomas [11] conduct a comparative analysis of laser technologies, which allows us to draw informed conclusions about the appropriateness of their use depending on the area of effect and skin type. In turn, Sepaskhah M. [10] highlights potential complications associated with laser intervention, in particular rare dermatological reactions.

The study also used expert literature, in particular online publications of the sites skinpuritys.com [6] alshifaalkhaleeji.com [12], which provide an idea of consumer

expectations, the availability of the technology and its popularity among a wide audience. Despite the sufficient amount of literature on this topic, there is a lack of systematic material on the comparative effectiveness and long-term safety of laser hair removal. Therefore, using various methods of scientific knowledge, the information was analyzed, grouped, systematized and presented in the light of the research topic.

The purpose of the article is to show the effectiveness of laser hair removal and traditional depilation and identify the key risks of these procedures. To achieve the goal, the ***following tasks*** will be performed during the study: the features and safety issues of traditional depilation methods are studied; the effectiveness and risks of laser hair removal are determined; the negative consequences of laser hair removal in the long term are shown.

Research Results

Traditional hair removal is a common aesthetic and hygienic procedure performed by all people. Methods of removing excess hair have evolved, but their essence remains unchanged to this day: hair is shaved, pulled out or dissolved.

Despite the rapid development of hardware and high-tech approaches, traditional hair removal continues to retain its priority and remains the basic and most common procedure, which is due to its accessibility, versatility and adaptability to individual needs. Modern achievements in this field have contributed to a significant improvement of classical methods, making them less traumatic, technologically simpler and providing a longer-lasting effect. In this context, the various types of natural hair removal, described in Table 1, attract special attention.

Traditional hair removal methods share a common feature: first, the lack of impact on the hair follicle as an anatomical and functional unit of hair growth; second, regardless of the mechanism of action (mechanical cutting, pulling out or chemical dissolution of the shaft), these approaches provide only a temporary cosmetic effect and require regular repetition of procedures. Mechanical methods, in particular shaving, are the most accessible and painless to use, but are characterized by the shortest duration of the result and an increased risk of superficial skin damage. Methods that involve removing hair from the root (waxing, sugaring, epilators) provide a longer

period of smoothness, but are associated with severe pain and a high frequency of ingrown hair and inflammatory complications. Chemical depilatories that act by destroying protein bonds in the hair structure are fundamentally different from traditional technologies. These creams allow the treatment of large areas of skin, but despite this, their use is limited due to the risk of irritation and allergic reactions, especially in people with sensitive skin [6].

Table 1 – Comparison of traditional hair removal methods

Hair removal method	Effectiveness	Skin risks
Shaving	The effect is short-term, lasting 1–3 days, as hair is only removed at the surface level of the skin.	Possible risks include cuts, irritation, erythema, folliculitis, and ingrown hairs.
Waxing	The effect is medium-term, lasting 2–4 weeks; hair is removed from the root, although the follicle remains intact.	This method may cause significant pain, a risk of burns from hot wax, post-inflammatory pigmentation, ingrown hairs, and skin irritation.
Sugaring	The effect is medium-term, typically lasting 2–4 weeks; hair is mechanically removed from the root.	It may lead to pain, irritation, minor skin injuries, and ingrown hairs.
Depilatory creams	The effect may be short- or medium-term, lasting a few days; these creams chemically dissolve the hair shaft.	Potential risks include allergic reactions, contact dermatitis, chemical burns, and an unpleasant odor.
Plucking (tweezers, epilator)	This method provides a localized effect and slows the regrowth of individual hairs.	It can cause pain, minor skin injuries, folliculitis, and a risk of developing ingrown hairs.

Note: systematized by the author based on [6]

Laser hair removal has a number of key advantages over traditional hair removal methods (shaving, waxing, sugaring), which determines its high popularity in modern dermatological practice. Unlike mechanical and chemical approaches, which provide only a temporary effect and require frequent repetition, laser technology acts directly on the hair follicle, selectively absorbing melanin and leading to a long-term reduction in hair growth [12].

However, just as traditional hair removal methods differ in their mechanisms of action and effectiveness, modern laser technologies are also represented by a wide range of different types of laser systems. These include ruby, alexandrite, neodymium and diode lasers, each of which is characterized by specific physical parameters,

different degrees of efficiency and different levels of safety, which, accordingly, causes differences in potential risks and clinical limitations. In view of this, it is advisable to consider in detail the features of the functioning of each of the above lasers, the principles of their interaction with biological tissues and the conditions of optimal use in the laser hair removal procedure.

The ruby laser with a wavelength of 694 nm is currently used much less often than before. Most often it is used not for hair removal, but for pigment lightening, tattoo removal and treatment of pigmented skin lesions [11].

The alexandrite laser with a wavelength of 755 nm is currently one of the most popular in the practice of laser hair removal. An important advantage of the alexandrite laser is the ability to work with light hair, which is limitedly available for other types of lasers [2].

The 1064 nm Nd:YAG neodymium laser has a wider clinical application. In addition to hair removal, it is used to treat vascular lesions, dermatological conditions and tattoo removal [7].

The 800–810 nm diode laser is currently considered a universal hair removal tool. It is characterized by effective melanin absorption, which ensures high efficiency in removing unwanted hair on various parts of the body. Diode systems are equipped with modern cooling systems, which increases the safety of the procedure. At the same time, at high energy settings, the procedure can be quite sensitive, so the best results are usually achieved in patients with Fitzpatrick phototypes I–V [3].

So, it can be stated that laser hair removal is an effective method of temporary and medium-term reduction of hair growth, the effectiveness of which significantly depends on the type of laser, the number of procedures, skin phototype and hair color. The most stable results are demonstrated by alexandrite and diode lasers with repeated use.

Also important are studies to determine the effectiveness of using a diode laser on different hair types (table 3).

Table 2 – Efficacy, safety and side effects of laser hair removal

Method (laser / technology)	Effectiveness	Duration of effect	Safety and side effects
Ruby laser [5]	Short-term hair reduction by 20–61%; four sessions are more effective than one (≈61% vs. 42%)	Limited long-term effect; after 12 months, most studies show no significant reduction	Low complication rate; hypopigmentation (more common in pigmented skin); less epidermal damage with 20 ms pulse
Alexandrite laser	High effectiveness with repeated sessions: 55–85% hair reduction; three sessions more effective than one	Better short- and medium-term results (up to 9–12 months) compared to a single treatment	Generally good safety profile; less pain and hyperpigmentation compared to diode laser; no scarring
Diode laser	Significantly better than shaving; 34–53% reduction after two sessions; up to 84% after four sessions	The effect can last up to 20 months with repeated treatments	Moderate pain; sometimes more hyperpigmentation and blistering than with alexandrite laser
Nd:YAG laser (long-pulsed)	Limited effect after one session; 40% of patients had >50% reduction after five sessions	Better long-term effect with multiple treatments (12–16 months)	Lower risk of pigmentation changes; more painful; blistering at high fluence levels
Nd:YAG laser (Q-switched)	Temporary hair reduction (up to 21%); full regrowth within six months	Short-term effect	Minimal side effects; limited effectiveness
IPL (intense pulsed light)	Average reduction of 49% after three sessions; more effective than ruby laser	Medium-term effect (6 months)	More frequent side effects (pain, pigmentation, crusting) than with ruby laser

Note: Systematized by the author based on sources [2, 3, 7, 11]

Thus, the results of the study confirm that the effectiveness of laser hair removal directly depends on the amount of melanin in the hair: the more melanin, the faster the desired effect is achieved and the fewer procedures are required. Side effects in the form of redness and skin irritation were observed in approximately 10% of clients and disappeared within 1–2 days, which indicates a high level of safety of the diode laser procedure.

It should be noted that laser hair removal is most effective in patients with fair skin and dark hair. In the case of fair, red or gray hair, the effectiveness of the procedure is reduced due to an insufficient amount of melanin. After the sessions, isolated side effects are possible, including erythema, pigmentation disorders, burns, itching of the skin and, in rare cases, eye damage if safety rules are not followed. Therefore, the use of protective glasses selected according to the wavelength of the laser is mandatory [1].

Table 3 – Effectiveness of laser hair removal and associated risks depending on hair color

Hair type	Effectiveness after 10 sessions	Nature of hair changes	Main risks and features
Black	The effectiveness is high	Hair growth almost stops completely, with only a few fine hairs remaining	Risks are minimal; temporary redness may occur
Brown	The effectiveness is good	Hair becomes significantly thinner and less dense, and growth slows down	The skin may be moderately sensitive; maintenance treatments might be necessary
Blonde	The effectiveness is moderate	Hair thickness is reduced, but the results may be uneven	Due to low melanin content, the overall effectiveness is limited
Red	The effectiveness is low	There may be a slight slowdown in hair growth, but consistent results are generally not achieved	Laser energy is poorly absorbed; clinical results are often lacking
Grey	The effectiveness is very low.	Stable results are not observed	The procedure is practically ineffective because of the absence of melanin
All groups			Redness and irritation occurred in approximately 10% of cases and subsided within 1–2 days

However, despite the fact that most cosmetologists claim that the laser hair removal procedure is completely safe, the literature records negative consequences that appear in the long term after the procedure. Some long-term effects of laser irradiation are associated with prolonged inflammation or changes in the immune response at the skin and mucous membrane levels. For example, constant irritation can cause chronic erythema (redness), increased skin sensitivity, or an increased risk of developing dermatoses in areas of previous exposure. Separately, the literature describes Fox-Fordyce disease - an inflammatory lesion of the apocrine sweat gland ducts, which sometimes occurs after laser hair removal, mainly in young women, and is most often localized in the armpits [10]. Also, repeated aesthetic laser treatments can lead to loss of subcutaneous fat, thinning of the dermis, and changes in the barrier functions of tissues. Hypo- or hyperpigmentation – changes in skin color in the treated areas, can also occur after prolonged use of the laser. These effects are described as "possible" in dermatological cases, they are due to individual reactions to thermal injuries or individual characteristics of remodeling after the procedure.

Conclusions

Traditional methods of depilation, including shaving, waxing, sugaring, the use of depilatory creams and mechanical plucking, remain the most common methods of removing unwanted hair due to their accessibility, simplicity and versatility of use. Their effectiveness is limited in time, as they do not affect the hair follicle and provide only a temporary cosmetic effect. From a safety perspective, traditional methods are associated with an increased risk of local damage: irritation, erythema, microtrauma, folliculitis, ingrown hair and allergic reactions, cuts, burns.

Laser hair removal, unlike traditional approaches, is based on the principle of selective photothermolysis and is aimed directly at damaging the hair follicle, which provides a longer-lasting effect of reducing hair growth. Modern laser systems, in particular ruby, alexandrite, diode and neodymium Nd:YAG lasers, differ in physical characteristics, clinical effectiveness and safety profile. Alexandrite and diode lasers demonstrate the most stable and predictable results, provided that multiple procedures are performed and the parameters are correctly selected according to the skin phototype and hair color. In general, laser hair removal is characterized by an acceptable level of safety, and most side effects are transient and limited to short-term local reactions.

However, scientific publications indicate that in some cases, laser hair removal may be accompanied by long-term undesirable effects, including persistent pigmentary disorders, chronic erythema, increased skin sensitivity, changes in dermal structure and, less commonly, the development of inflammatory dermatoses. The risk of such complications increases with non-compliance with safety protocols, incorrect selection of radiation parameters or ignoring individual patient characteristics, which emphasizes the need for a balanced and scientifically based approach to the use of laser technologies in hair removal practice.

References

1. Atta-Motte M., Załęska I. Diode laser 805 hair removal side effects in groups of various ethnicities – cohort study results. J Lasers Med Sci. 2020. № 11(2), 132–137. DOI: 10.34172/jlms.2020.23

2. Bonan P. Laser and light-based hair removal. PMFA News. 2017. № 4 (Apr/May). URL: https://www.thepmfajournal.com/features/features/post/laser-and-light-based-hairremova

3. Cannarozzo G. Trunk hair removal treatment with diode laser 810 nm in men population. Dermatol Reports. 2023. № 16(1), 9736. DOI: 10.4081/dr.2023.9736

4. Gold M.H. Novel laser hair removal in all skin types. J Cosmet Dermatol. 2023. № 22(4), 1261–1265. DOI: 10.1111/jocd.15674

5. Haedersdal M. Evidence-based review of hair removal using lasers and light sources. Lasers in Medical Science. 2006. № 20(1), 9–20. URL: https://onlinelibrary.wiley.com/doi/10.1111/j.1468-3083.2005.01327.x

6. Laser Hair Removal Vs. Traditional Hair Removal Methods: Pros and Cons. skinpuritys.com, без дати. URL: https://www.skinpuritys.com/Blogs/laser-hair-removal-vs-traditional-hair-removal-methods-pros-and-cons.html

7. Nistico S.P. Comparing traditional and in motion Nd:YAG laser in hair removal: a prospective study. Medicina (Kaunas). 2022. № 58(9), 1205. DOI: 10.3390/medicina58091205

8. Rafi S. Efficacy and safety of diode laser for facial hair reduction in hirsutism: a clinico-trichoscopic evaluation. J Cutan Aesthet Surg. 2024. № 1, 19–24. DOI: 10.4103/JCAS.JCAS_63_23

9. Saleh D. Hypertrichosis. Statpearls.com, 2023. URL: https://www.ncbi.nlm.nih.gov/books/NBK534854/

10. Sepaskhah M. Hair removal laser-induced Fox-Fordyce disease emerging on the axillary and pubic areas: report of a case and review of literature. Clin Case Rep. 2024. № 12(3). DOI: 10.1002/ccr3.8621

11. Thomas M.M. The “ins and outs” of laser hair removal: a mini review. J Cosmet Laser Ther. 2019. № 21(6), 316–322. DOI: 10.1080/14764172.2019.1605449

12. Why Laser Hair Removal Is So Extremely Popular as a Substitute for Other Hair Removal Treatments. alshifaalkhaleeji.com. URL: https://alshifaalkhaleeji.com/why-laser-hair-removal-is-so-extremely-popular-as-a-substitute-for-other-hair-removal-treatments/