

GUIDELINES

Photo-Epilation: Guidelines for care from the European Society for Laser Dermatology (ESLD)

MICHAEL DROSNER¹ & MAURICE ADATTO²

¹Cutaris Zentrum für Haut-, Venen- und Lasermedizin, Munich, Germany, and ²Skinpulse Dermatology Center, Geneva, Switzerland

Abstract

Laser- or flashlamp- (also called intense pulsed light source or IPLS) assisted hair removal is a well tolerated and effective technique for patients who desire permanent reduction of hair growth. Although laser and light sources are very popular because of their non-invasive nature and the speed at which they operate, practitioners and patients have to be cautious to avoid permanent side effects instead of permanent hair reduction. These guidelines focus on patient selection and treatment protocol in order to provide safe and effective treatment. The ideal patient for laser hair removal is light skin with black coarse hair. Blond, grey and white hair does not respond to treatment. Individuals with dark skin, and especially tanned patients, are at higher risk for pigmentary changes. Sunscreen before and after treatment will produce and maintain untanned skin. The type of laser or IPLS and their specific parameters must be adapted to the patient (hair thickness, pigment concentration, Fitzpatrick skin type). Treatments should start on a test patch and a treatment grid can improve accuracy. Pre-, parallel and post-cooling, as well as a reduction of the fluence, will prevent adverse effects such as pigment alteration and scar formation. Average rates of long-term hair reduction are reported at between 70% and 90% at 6 months follow-up. At least three repeated treatments should be done to achieve partly permanent epilation.

Key words: *Guidelines, hirsutism, hypertrichosis, intense pulsed light source, IPLS, laser hair removal, photoepilation*

Introduction

This report reflects the best data available at the time the report was written (March 2005), but caution should be taken when interpreting the data. Results of future studies may require changes in the conclusion or recommendations set forth in this report. Ideal treatment parameters must be individualized for each patient and with each device.

Actual knowledge on photoepilation

Photoepilation is a technique for long-term removal of unwanted hair by thermal destruction of the hair follicle and its reproductive system (stem cells). The heat is caused by selective absorption of electromagnetic radiation emitted by different light sources, mainly by lasers and intense pulsed light sources (IPLS) (high-intensity incoherent and multichromatic pulsed light). As melanin is the main chromophore existing in hair follicles, the corresponding wavelength spectrum would range from

ultraviolet (400 nm) up to infrared light (1200 nm). Furthermore, longer wavelengths are preferred as the chromophore lies deep in the skin and the penetration of light increases with the wavelength. Thus, in the range of 600–1100 nm, melanin absorption may be used for selective photothermolysis of hair follicles. The following light sources have proven successful for a variety of skin types: ruby laser (694 nm), alexandrite laser (755 nm), diode laser (800–810 nm), neodymium:yttrium aluminium garnet (Nd:YAG) laser (1064 nm) and different IPLS emitting a broad spectrum from 550 to 1200 nm depending on the cut-off filter.

Regardless of the type of system used, multiple treatments (three to eight) performed every 4–8 weeks are necessary to achieve satisfactory results. Average rates of long-term hair reduction are reported at between 70% and 90% at a minimum of 6 months (1,2). The efficiency of the different light sources is comparable except for the long-pulsed Nd:YAG laser at 1064 nm, which is safer in subjects with darker skin. Patients with dark hair and

Correspondence: Michael Drosner, cutaris Zentrum für Haut, Venen und Lasermedizin, Candidplatz 11, D-81543 Munich, Germany. Fax: +49 89 65126570. E-mail: drosner@cutaris.de

(Received 1 December 2004; accepted 15 January 2005)

light skin are ideal candidates for photoepilation. Often, regrowing hairs are thinner and lighter in colour. It is generally believed that hair follicles are more responsive to treatment while they are in the growing (anagen) phase. So far there is no known most favourable treatment site; however, the chin area shows the weakest clearance rate and the back might have a high recurrence rate in some individuals (e.g. Mediterraneans).

Side effects after photoepilation include erythema and perifollicular oedema, which are common, as well as crusting, vesiculation, hypopigmentation and hyperpigmentation (depending on skin colour and other factors leading to excess heat production). Most complications are generally temporary (2,3). After severe burns, hypopigmentation and scar formation may be permanent side effects.

Photoepilation has become a well established technique for hair growth control. However, despite considerable technical advances in this field, these devices still have the potential to cause injury when used improperly. It is important to follow precise treatment guidelines in order to attain safe and optimal results. The following treatment and safety guidelines are provided to assist the practitioner in the use of these devices.

Guidelines for photoepilation (treatment and safety guidelines)

Indications

Though most patients undergo photoepilation primarily for cosmetic reasons, medical causes for excessive hair growth should be sorted out before treatment. Hypertrichosis (excess hair at any body site) is mainly genetic or ethnic, but is also seen secondary to endocrine disturbances, malnutrition, porphyria, and medication. Hirsutism (excess hair in androgen-dependent sites in women) can be idiopathic or it could occur secondary to endocrine disorders, medication, and virilising tumours (4). Another indication for photoepilation might be chronic pseudo-folliculitis caused by ingrowing hair, most frequently found at the bikini line or on the legs of women but also on black-skinned patients and called 'shaving bumps'.

A detailed medical history and examination should identify the cause of hirsutism.

Patient selection

Proper patient selection is mandatory for reasonable success rates. The ideal patient has normal or thick, dark-coloured hair and pale skin. The darker the skin colour and the brighter and/or thinner the hair the less effective the photoepilation will be. Patients always should be scanned for unrealistic expectations.

Patient information and consent

All subjects, especially those with a questionable outcome (dark skin colour, light brown or blond hair colour, thin hair), should be informed about the possibility of hair regrowth. Possible side effects and complications should be discussed and filled in on the consent form before the treatment starts. Topics to mention are: multiple treatment, partial or complete regrowth, permanent hair loss (especially when the wish of epilation is born on fashion rules or society conventions), prolonged erythema, oedema, swelling, blister, crust or scar formation, (permanent) pigmentary changes (hypo- and hyperpigmentation), growing of thinner or paler hair, induction of hair growth and/or transformation of velus hair into terminal hair in neighbouring areas (which are not treated for hair removal).

Pre-laser treatment care

To obtain an optimal result the patient should be advised to get the palest skin colour possible. A broad-spectrum sunscreen with SPF 40–60, started at least 4 weeks prior to the first treatment, would be sufficient to achieve pale skin even during the summer time. In severely tanned subjects, bleaching agents are recommended. No plugging, waxing, or electrolysis should be performed before a photoepilation session (because the light needs melanin in the hair shaft and follicle as chromophore to be absorbed). The growing hair can be cut, or shaved or treated with depilatory cream, although they may create irritation of the skin. The skin area to be treated should be free of make-up. To get started, the rim of the treatment area is marked with a white pen, as the colour white will not absorb the light. In distinct areas this border line should be marked by the patients themselves (using a mirror), reflecting their personal wishes. The outlined area is shaved and cut hair is removed by adhesive tape to prevent superficial burns by hair pieces lying on the surface. In larger areas, a treatment grid (painted in white) could be useful to avoid double treatment or skipped areas.

Benign melanocytic lesions, such as naevi, should be covered with a white light-proofed tape to avoid absorption by the melanin during the hair removal session. As photoepilation is not a painless procedure, topical anaesthetic cream could be applied 1 hour before the scheduled treatment. However, anaesthesia is not suggested in general because pain is the best early warning system to prevent side effects caused by heat destruction.

Of course, before getting started (and during longer treatment sessions) the equipment should be checked: the handpiece must be undamaged and clean as crusts on the glass window or sapphire will cause hot spots on the surface of the skin with consequent burn marks. Then correct parameters

(pulse duration and fluence are sometimes mixed up), which are the most important points of interest, should be selected.

Choice of the right instrument

There are two principles to treat with hair removal: contact and non-contact. IPLS and lasers such as ruby, diode and Nd:YAG mostly work as contact devices, often combined with an inbuilt cooling handpiece, where a sapphire or glass lens is used for direct contact to the skin surface. The contact method allows for application of pressure on the skin surface, which decreases the distance from the epidermis to the deeper follicular structures. In addition, the pressure blanches the underlying blood vessels, minimizing absorption of laser energy by haemoglobin. The non-contact method is mainly used with alexandrite, as well as with some Nd:YAG and ruby lasers, where the laser beam leaves the handpiece above the skin surface. These lasers are often combined with cold air ventilation cooling or with a dynamic cooling device (DCD) to protect the epidermis. Together with non-contact devices, a smoke evacuator is useful if available as hair shafts will burn off with smoke production.

Because the efficiency of different light sources is comparable, the selection of the right laser or light source does not really matter. However, the ruby laser, once one of the first lasers introduced for hair removal (5), now has a minor role. Its optimal absorption in melanin is also connected with a higher risk of side effects, especially in tanned subjects, and its light is the least penetrating of all epilation devices. The main work in photoepilation is done either by the alexandrite laser (6,7), diode laser and IPLS (8). These flashlamps may be used with the same principles of selective targeting by the proper choice of wavelength spectrum, pulse characterization, and fluence. Regarding safety, the Nd:YAG laser is increasing in interest, especially in tanned patients and individuals with skin types IV–VI.

In order to heat up thin hair or lighter coloured hair, the system should provide enough energy with shorter pulse durations (15 ms and shorter). On the other hand, longer pulse durations should be available for safety reasons to treat darker pigmented skin. According to their different thermal relaxation time, the thin layers of the pigment-containing epidermis will cool down with longer pulse durations while the thicker follicle will constantly absorb the heat.

Finally, the speed of epilation during a session is an important factor influencing the selection of the right system. Bigger spot size, scanner and high repetition rates guarantee short treatment times, which is important when larger areas such as the back or legs are treated.

Epilation treatment

In laser therapy, each of the following four parameters has to be individually selected and adapted to the clinical situation. The following order of these parameters is easy to remember: wavelength, beam diameter (spot size), pulse duration and fluence (energy density per cm^2).

Wavelength. Shorter wavelengths are more effective in light brown and thin hair, longer wavelengths are deeper penetrating and are safer to use in darker pigmented skin types. This is also true for wavelength ranges emitted by IPLS. Distribution of energy per wavelength varies considerably between the different flashlamp systems and their exchangeable handpieces. The user should know the specific design of distribution in order to select the optimal range for a specific clinical situation.

Spot size. The bigger the spot size the deeper the light will penetrate into the skin by forward scattering. Also, the speed of treatment is faster with bigger spot sizes. In laser systems, the spot size should be at least 10 mm (while running in high fluences). Scanning devices just help to apply the laser pulses on the skin. They have no benefit for the individual pulse diameter.

Pulse duration. There is no difference in efficacy between pulse durations of 10, 20, 30 or 40 ms. Much longer pulse durations do not show an additional increase of hair reduction rates. Shorter pulse durations have a higher risk of heating up the pigmented epidermis, which may cause problems such as discolouration or scars. Therefore, within the borders of 10–40 ms, the pulse width can be adapted to the grade of skin pigmentation and to the content of pigment in the hair: the less pigmented and the thinner the hair the shorter the pulse duration should be.

Fluence. The level of energy density is different with each laser or IPLS, corresponding to the specific absorption in melanin. In general, the efficacy of hair removal increases with the darkness of the hair colour and the amount of energy presented to the skin. Although in alexandrite laser therapy low-dose epilation (10–15 J/cm^2) is effective and shows a considerable high rate of hair reduction (50–60% at 3 and 6 months follow-up), higher fluences (25–30 J/cm^2) reach a higher degree of hair reduction. The therapeutic dosage for diode lasers (800 nm) ranges between 20 J/cm^2 and 40 J/cm^2 , going up to more than 50 J/cm^2 in pale subjects for very thin hair. As the fluence is the main parameter causing adverse effects by overheating the surrounding tissue of the hair follicles and/or the pigmented epidermis, every treatment should be started with low fluence levels, increasing step by step. Zones of danger are

the chin region (higher density of hair follicles) and the pigmented genital area.

The optimal parameters vary considerably between each laser/IPLS and between patients. Therefore, it is recommended that a test treatment is performed on a representative but small area.

Before the laser or IPLS is started every person in the treatment room (including the patient) should wear safety goggles designed for the specific wavelength or range of wavelength emitted by the light source.

When needed, a thin layer of gel (optical indifferent ultrasound gel) is applied to the area to be treated in order to enable the handpiece to glide on the skin and to improve the temperature exchange with the skin surface. Using a contact technique, the laser or flashlamp handpiece can be pressed on the skin to cause anaemia, which excludes the haemoglobin (as a potent and competing chromophore) and diminishes the distance down to the hair root. The handpiece is pressed on the skin step by step with minimal overlap (10%). The contact method is mainly used for diode and Nd:YAG lasers as well as for flashlamps. The handpiece of the alexandrite laser normally works as a non-touch system with a distance tip, either as a single handpiece or as a scanner handpiece. To avoid untreated gaps or double treatment spots the area should be divided in smaller areas by a grid or stripes.

The treatment should be started in a small but representative test area using the biggest spot size available and the highest tolerable fluence. When the treatment is on the face, the patch test is usually selected on the submental area where adverse reactions cosmetically are less obvious. The treatment is painful, but the pain should always be tolerable. If the patient is complaining about intolerable pain the risk of adverse effects is high. Signs of side effects and proper treatment endpoints are very close and should be sorted out carefully.

Treatment endpoints and initial signs of adverse effects

The ideal immediate response to photoepilation treatment is vaporization of the hair shaft with no other apparent effect.

Erythema. Shortly after the photoepilation an erythema will occur, mainly spotted, but sometimes homogeneous and widespread. The erythema correlates with the degree of epidermal stress (mainly caused by the absorption of the emitted light in melanin transformed directly into heat). In pale subjects the erythema may be absent. Therefore, the erythema is a good marker for damage to the epidermis or the epidermal-dermal junction. A reduced fluence and longer pulse durations could avoid this problem. With adequate cooling the erythema will disappear within 10–60 minutes.

Oedema. Perifollicular oedema is a clear sign of thermal damage to the follicle and therefore a marker of the treatment endpoint. The oedema occurs after a few minutes and should remain perifollicular. In the case of diffused heat, destruction is no more limited to the follicles. In these cases either the fluence is too high or the density of follicles is too high (e.g. chin region). Widespread oedema therefore could be an early sign of necrosis of the dermis. Reduction of the fluence and intense cooling will avoid this adverse effect.

Discolouration. Grey or pale white discolouration of the epidermis again is a sign of early dermal damage, indicating inappropriately high fluences. This sign will last only some seconds. Blister formation, epidermal disruption and necrosis of the epidermis (and of the dermis in severe cases) will follow. Intense cooling, reduction of fluence and prolongation of the pulse duration are consequent reactions.

Because these findings can be immediate or delayed, it is important to carefully observe the treated test spot for at least 5 minutes before proceeding with full treatment

Cooling

As mentioned before, cooling is the best first-aid to avoid adverse effects caused by photoepilation (post-cooling). But cooling is also helpful before (pre-cooling) and during (parallel cooling) treatment. Pre- and parallel cooling preserve the (pigmented) epidermis from being heated up too much during treatment. Post-cooling helps to prevent heat damage to the tissue surrounding the follicle. Cooling also is very useful for the treatment of dark skin types (IV–VI).

Three mechanisms of cooling are adequate: contact cooling (cooled sapphire, metal or glass plates built into the handpiece), cold air ventilation and DCDs, where gases (cryogen, tetrafluoroethane) are used as surface cooling agents. According to the efficacy of photo-epilation no influence could be found at least for cold air cooling (9).

Post-laser treatment care

The parallel cooling should be continued after treatment until any pain or redness has disappeared. Ice packs will have the same effect. Cooling also minimizes the heat-induced oedema. Topical corticosteroids could be prescribed to reduce erythema and swelling in patients with a positive history of prolonged redness or extensive oedema. After 1 day, visible hair shafts can easily be pulled out. As long as mild signs of inflammation (clearing action) are visible, sun exposure should be avoided (unless sun protection is used: SPF 60) to prevent

post-inflammatory hyperpigmentation. Within the first weeks after treatment, some shedding of the treated hair may occur, which sometimes is mistaken as regrowth by the patients. Up to the next treatment session regrowing single hairs should be clipped (instead of waxing or plucking). To maintain the pale skin, sunscreen should be used until the next treatment. Make-up can be used immediately after treatment except if blistering occurs.

Follow-up

Temporary hair loss (1–3 months) always occurs after laser treatment, regardless of hair colour or device used. Regardless of the system used, multiple treatments (three to eight) performed every 4–8 weeks are necessary to achieve long-lasting hair removal. Average rates of long-term hair reduction are reported at between 70% and 90% at a minimum of 6 months. Performing only a single treatment in most cases may lead to complete regrowth. At least three repeated treatments should be done to achieve partially permanent epilation.

Physician qualifications

The physician using photoepilation should have a completed residency training in an appropriate specialty such as dermatology and he/she should have a general knowledge of basic laser physics, laser–tissue interaction, and laser safety. Before starting treatments, the physician should attend appropriate laser training courses including hands-on experience or work under the supervision of an appropriately trained laser expert (10).

Delegation of photoepilation

When performed by physician extenders under the supervision of a physician, maximal use of time and resources can be achieved, keeping a high standard of safety. The staff should be trained initially at least during 1 year and be updated continuously thereafter to have enough insight into adverse effects and how to avoid them. The physician delegating the treatment should be aware that patients are always more critical with mistakes caused by physician extenders.

Adverse effects and safety precautions

As all photoepilation systems are designed for deep penetration and strong absorption in melanin, they have a high potential for eye injury (thermal destruction of iris and retina). Treatment near the eye is not recommended unless the eyes are covered with metal lenses. Therefore, proper eye protection is necessary for all persons within the operating room (including the patient).

To avoid side effects while trying to obtain optimal results, the fluence must be tailored to the patient's skin type and density of hair follicles. Inappropriately high fluences and poor patient selection may result in scarring and pigmentary changes. Hyper- or hypopigmentation may occur in cases treating dark-skinned individuals or even pale subjects 1–4 days after UV exposure. Loss of freckles or of the brown colour of pigmented lesions may occur. Because we do not know the possible influence of laser or IPLS treatment on melanocytic naevi, the treatment of pigmented naevi should be avoided, or these lesions should be covered with white adhesive tape.

Methods to reduce the incidence of adverse effects include lightening of the skin and sun avoidance prior to laser treatment, cooling of the skin during treatment, sun avoidance and protection after treatment. Cooling devices, either spray or contact cooling, are helpful in protecting the epidermis, but may not be sufficient to protect tanned or darker skinned patients. Patients with a tan should delay treatment until the tan fades. Darker skinned patients should be treated with longer pulse durations or with the Nd:YAG laser together with appropriate cooling. Nothing should be allowed to heat up the epidermis (look for debris on the handpiece and on the skin surface). Always remember that low-dose treatment may be a solution in cases of a high density of hair, pigmented epidermis or both (11).

Individuals with a history of hypertrophic scarring or keloids should be treated with caution (use a test spot).

Pregnancy

Although laser or IPLS hair removal physically has no impact on pregnancy, most laser manufacturers exclude the use of photoepilation in pregnant women in their application notes. However, in many countries, the operator performing the photoepilation has to prove the non-interference of the hair removal procedure with the pregnancy. Photoepilation should be discontinued in the first two trimesters of pregnancy. In the third trimester, photoepilation can be undertaken within the responsibility of the physician, as the foetus is completely formed and there is no more known risk of foetal malformation.

Disclaimer

Adherence to these guidelines will not ensure successful and safe treatment in every situation. The ultimate judgement regarding the propriety of any specific procedure must be made by the physician in light of all the circumstances presented by the individual patient.

Supporting evidence

These guidelines of care for photoepilation are based on the experience of members of the European Society for Laser Dermatology (ESLD) and on review articles in the literature (12–14). Articles supporting the statements mentioned in these guidelines are listed in the reference and bibliography sections.

References

1. Dierickx CC, Grossman MC, Farinelli WA, Manuskiatti W, Duque V, Lin D, Anderson RR. Hair removal by a pulsed, infrared laser system. *Lasers Surg Med.* 1998;S10:198.
2. Lepselter J, Elman M. Biological and clinical aspects in laser hair removal. *J Dermatolog Treat.* 2004;15:72–83.
3. Nanni CA, Alster TS. Laser-assisted hair removal: side effects of Q-sw. Nd:YAG, long-pulsed ruby and alexandrite lasers. *J Am Acad Dermatol.* 1999;41:165–71.
4. Kvedar JC, Gibon M, Krusinski PA. Hirsutism: Evaluation and treatment. *J Am Acad Dermatol.* 1985;12:215–25.
5. Grossman MC, Dierickx CC, Farinelli W, Flotte T, Anderson RR. Damage to hair follicles by normal-mode ruby laser pulses. *J Am Acad Dermatol.* 1996;35:889–94.
6. Finkel B, Eliezri YD, Waldman A, Slatkine M. Alexandrite laser technology for non-invasive hair removal. *J Clin Laser Med Surg.* 1997;15:225–9.
7. Garcia C, Alamoudi H, Nakib M, Zimmo S. Alexandrite laser hair removal is safe for Fitzpatrick skin types IV–VI. *Dermatol Surg.* 2000;26:130–4.
8. Stangl S, Drosner M, Hertenberger B. Epilation with a diode laser compared to a flash light: Quicker and more permanent? *Lasers Surg Med.* 2001;S13:54.
9. Drosner M, Stangl S. Does cooling with cold air influence the efficiency of foto epilation? *Med Laser Appl.* 2001;16:161.
10. Dover JS, Arndt KA, Dinehart SM, Fitzpatrick RE, Gonzalez E. Guidelines of care for laser surgery. *J Am Acad Dermatol.* 1999;41:484–95.
11. Drosner M, Stangl S, Hertenberger B, Klimek H, Pettke-Rank C. Low dose epilation by alexandrite laser: A dose response study. *Med Laser Appl.* 2001;16:293–8.
12. Dierickx CC, Alora MB, Dover JS. A clinical overview of hair removal using lasers and light sources. *Dermatol Clin.* 1999;17:357–66.
13. Hobbs L, Ort R, Dover JS. Synopsis of laser assisted hair removal systems. *Skin Therapy Lett.* 2000;5:1–5.
14. Liew SH. Laser hair removal. Guidelines for management. *Am J Clin Dermatol.* 2002;3:107–15.

Photo-Epilation -

Leitlinie der European Society of Laser in Dermatology (ESLD)

Die Photo-Epilation ist eine anerkannte und ziemlich effektive Enthaarungsmethode für Patienten, die eine anhaltende Haarentfernung wünschen. Obwohl Laser- und IPL/I²PL-Lichtepilation als nicht-invasive und schnelle Enthaarungsmethoden sehr beliebt sind, müssen sich Behandler und Patienten vorsehen, statt permanenter Enthaarung nicht permanente Nebenwirkungen zu erzielen. Diese Leitlinien betonen insbesondere Patientenauswahl und Behandlungsprotokoll um sicheres und effektives Behandeln zu ermöglichen. Der ideale Patient für eine Photo-Epilation ist hellhäutig und hat dunkle, festere Haare. Blonde, graue und weiße Haare sprechen nicht auf die Photo-Epilation an. Dunkelhäutige Personen und vor allem gebräunte Patienten riskieren Pigmentveränderungen. Sonnenblocker vor und nach der jeweiligen Behandlung fördern und erhalten die Blässe der Haut. Der Laser- oder Blitzlichttyp und deren spezifischen Parameter müssen auf den jeweiligen Patient abgestimmt werden (Haardicke, Pigmentgehalt der Haare, Pigmentierungsgrad der Haut. Der Behandlungsbeginn in einem Probeareal und die Einzeichnung eines Behandlungsgitters (Hilfslinien) helfen die Genauigkeit der Behandlung zu erhöhen. Vorkühlung, parallele Kühlung und Nachkühlung als auch die Begrenzung der Energiedichte helfen Nebenwirkungen wie Pigmentverschiebungen oder Narbenbildung vorzubeugen. Die durchschnittliche anhaltende Haarreduktion liegt zwischen 70 und 90% bei einer Nachbeobachtung von 6 Monaten. Für eine anhaltende Enthaarung sollte die Behandlung wenigstens dreimal wiederholt werden.

Schlüsselwörter

Laser-Haarentfernung, Photoepilation, Leitlinien, Hypertrichose, Hirsutismus, Intense pulsed light IPL