Intense Pulsed Light (IPL) Technology

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16.1 Technology

The abbreviation IPL stands for intense pulsed light. IPL technology is a high-energy flashlamp which, unlike lasers, emits light. The radiation of the polychromatic light lies in a spectral range between 250 and 1200 nm, i.e., from the ultraviolet (UV) to the infrared (IR) range, and in pulsed operation corresponds to a wavelength spectrum similar to that of the sun.

The first system on the market to use IPL technology was the Photoderm (ESC, Yokneam, Israel) in 1994. Today there are many different IPL manufacturers.

The abbreviation IPL is usually used for intense pulsed light or flashlamp technology but is now a registered trademark of a laser and IPL manufacturer (Lumenis). Some manufacturers bypass trademark protection by using a wide variety of name additions. Frequently only high-energy pulsed noncoherent light sources are spoken of.

The decisive component of IPL technology is a gas discharge lamp in the form of a flashlamp. A high-energy high-pressure xenon lamp is preferred. There are two construction forms for the lamps:

- A rod-shaped short arc lamp.
- A U-shaped lamp.

These technical options also determine the shape of the treatment handpiece, as the lamps are located directly in the handpiece.

In contrast to many other lasers, the combination of arc lamps and handpieces means that the treatment area of some IPL devices cannot be completely seen during therapy because the handpieces are too large.

First, a high-voltage pulse is generated in an electronic ballast, which makes the gas conductive in the rod-shaped discharge tube made of quartz glass. The gas discharge is then ignited with the formation of a linear arc between the two tungsten electrodes in the discharge tube.

Technically, the most frequently used xenon flashlamps (gas discharge lamps) are line emitters, with about 85% of the total optical radiation being found in a continuum, while the remaining about 15% is accounted for by the line spectrum. Additives in the gas cause the lines to be so close together that they almost become a continuous spectrum, especially in the wavelength range from about 300 nm to about 700 nm.

The **emission spectrum** is determined by the choice of the gas mixture used and the various metal salts. Xenon produces a broadband optical radiation emission, which often corresponds to a daylight-like white. In the visible range, the maximum is about 500 nm. The xenon spectrum in the near infrared has strong lines (plasma lines)

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between 800 nm and 1000 nm and weak lines between 450 nm and 490 nm.

All the radiation from the gas discharge lamp contains ultraviolet (UV) and infrared (IR) radiation that is dangerous for the skin. Therefore, these radiation components hazardous for the treatment must be removed. Technically, in the shortwave range, optical "cutoff filter" filters out the UV radiation. Cutoff filters of different wavelengths (515 nm, 590 nm, 615 nm, 645 nm, 695 nm, 755 nm) are used.

The cutoff filters only remove wavelengths below their specified wavelength.

Some IPL devices do not filter out all the radiation above the specified wavelength and completely penetrate the skin. These long-wave wavelengths, which also lie in the infrared range, can lead to nonspecific heating of the tissue and thus to skin burns. By using a water supply section, wavelengths between 750 nm and 1200 nm can also be filtered out in the long-wave part of the radiation of the gas discharge lamps.

However, depending on the cutoff filter, this means that 70 to 90% of the radiated energy is not in the visible spectral range, which is well usable for the treatment of the main chromophores hemoglobin and melanin. In order to generate therapeutically effective amounts of energy, for example, in the field of hemoglobin absorption, an unspecific heating of the tissue by infrared radiation must be accepted.

Choosing these **filters** allows for a certain amount of adjustment to be made for the particular application and adaptation to the skin type at hand.

Wavelengths in the range from 515 nm to 1200 nm are mostly used for the treatment of the skin. However, this is different for many IPL devices and depends on the device manufacturer. Depending on whether the infrared range is also to be used for the depth effect, the wavelength range above 950 nm is also suppressed. This eliminates the effect of the infrared range, especially on the water in the skin.

All IPL systems are pulsed by the use of flashlamps. The **pulse durations** lie between 5 ms and 50 ms and can be selected individually. The frequency and the intervals between the pulses can also be freely set. Pauses between pulses ensure more effective cooling of the skin, which optimizes treatment results and reduces the rate of side effects.

Since the IPL devices have spontaneous incoherent optical radiation, their radiation surface (**spot size**) is significantly larger than that of the laser with its stimulated coherent radiation. Different dimensions are possible by using different glass spots. These can range from a few millimeters to several square centimeters. In order to achieve such large treatment areas with lasers, special scanning techniques or laser heads with many small individual lasers must be used. However, these large treatment heads have the disadvantage that it is not possible to see the entire treatment area and the entire therapeutic area—e.g., the face—cannot be treated homogeneously.

For an assessment of the **application range** of an IPL device, the following information should be available if possible:

- Spectral wavelength spectrum depending on the respective handpiece and filter.
- Maximum irradiation (energy density) per handpiece of the single pulse and pulse sequence.
- Irradiance distribution (area power density distribution) on the handpiece.
- Pulse duration.
- Pulse repetition frequency.
- Average optical power over 1 s or 10 s in watt.

The essential specification for the required laser radiation or flashlamp emission for a skin treatment is that of the energy density (irradiation), i.e., the power density (**irradiance**) and exposure duration. This relationship is expressed in the unit joule per square centimeter (J/cm^2) and usually referred to a certain pulse duration. In the literature and especially in the data sheets of the device manufacturers, the designation "fluence" is a term that actually originates from dosimetry and is associated with particle radiation. Typical values of the energy density are in the range of 20 J/cm^2 up to 60 J/cm^2 if the corresponding pulse durations are in the millisecond range.

Modern IPL devices can be used very variably in wavelength, pulse duration, and pulse sequence (Fig. 16.1). Due to these variation possibilities,

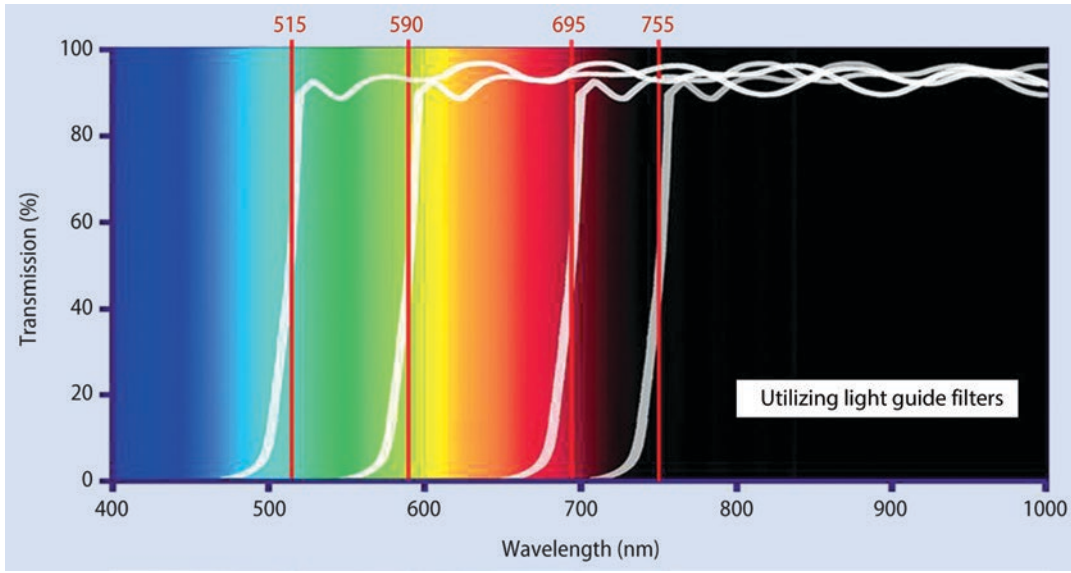

Fig. 16.1 IPL spectra (Lumenis©)

the IPL technique offers a wide range of treatment parameters for a broad spectrum of different skin changes.

16.2 Indications

Possible treatment structures for flashlamp therapy are as follows:

- Superficial vessels and skin redness (Fig. 16.2).
- Pigmentations.
- Hair.

This results in an enormously wide range of applications for IPL technology.

Possible indications with the primary goal of superficial vessels are the following:

- Infant hemangiomas, which occur in as many as 10% of newborns.
- Congenital vascular malformations.
- Naevi flammei.

The therapeutic spectrum also includes later vascular skin changes such as senile angiomas, spider nevi, vascular ectasia, rosacea (Fig. 16.2), flushing, and erythrosis colli. In the case of pigmented lesions, post-inflammatory hyperpigmentation of any genesis as well as age-related discolorations such as age spots can be excellently treated.

However, the removal of nevus cell nevi is not primarily an indication for IPL treatments. These should continue to be surgically removed and histologically clarified. Numerous studies also prove the enormous effectiveness and above all the long-lasting effect of the IPL technique in photoepilation.

16.3 Fundamentals of Medical Application

With the Photoderm® of ESC/Sharplan, Israel, the first market-ready system based on IPL technology was available in 1994. First in the version Photoderm® VL for superficial fine vascular lesions (vascular changes of the skin), later in extension to pigmented lesions (PL) and photoepilation (HR = hair removal). The high flexibility of the devices and the associated numerous setting parameters (wavelength, pulse duration, pulse strength, pulse number, pause duration between pulses, etc.) finally led to the further

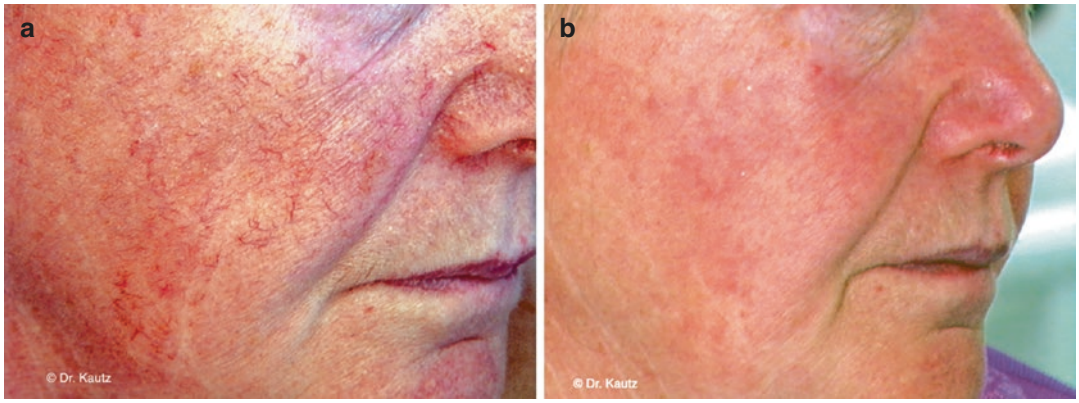

Fig. 16.2 (**a**, **b**) Telangiectasias, rosacea: (**a**) before and (**b**) after IPL therapy

development of more user-friendly alternatives, such as Quantum with the possibilities SR (=skin rejuvenation: extensive skin rejuvenation, especially in the case of light-induced skin aging symptoms) and HR (=hair removal: photoepilation), with treatment optimized parameters already specified for this. In the meantime, there are a large number of suppliers on the market who sell devices with flashlamp technology (alone or in combination with other technologies). The latest IPL system on the market is Lumenis' M22™ system.

However, a precise overview of the individual companies or devices makes no sense, since, similar to computer systems, technical innovations are constantly coming onto the market. Any overview would thus become obsolete after publication. In a purely physical sense, IPL devices are not lasers, although the effectiveness of the method is based on the same principles as laser therapy. The devices are therefore always compared with lasers in terms of indication, efficacy, and side effects. The wavelengths used at IPL are between approx. 500 and 1200 nm. Thus, high absorption values, e.g., for hemoglobin and melanin can be found in the applied light spectrum. This is the physical basis for the effectiveness of the IPL technique in vascular malformations and pigmented skin changes. The pigment of the hair matrix also seems to be an important goal during epilation, because light or nonpigmented hair responds much worse to photoepilation than strongly pigmented hair. Further effects on other possible target structures such as collagen connective tissue and sebaceous glands and bacterial colonization of the skin are discussed and are the basis of several clinical studies. Currently, intensive studies on the mechanisms of action of laser and IPL therapies are being carried out in cell cultures. Depending on the skin change to be treated and the type of skin present, special parameters can be selected for the IPL technique that offer optimum protection of the surrounding structures with maximum target effect. As with the numerous non-ablative laser systems, the active principle of IPL technology is based on the principle of selective photothermolysis.

16.4 Practical Implementation

Pretreatment

A detailed diagnosis of the diseases to be treated and an intensive education of the patients are a fundamental and inevitable part of the preparation phase of any IPL therapy!

In the case of congenital vascular anomalies, early detection and diagnosis with consistent follow-up is the first priority.

In addition to precise clinical documentation, sonographic examination of the affected areas is indispensable.

Ideally, a decision can thus be made as early as possible as to whether the findings are changes in urgent need of treatment, e.g., rapidly growing

hemangiomas in the facial area or at body orifices, or whether a mere wait and see without any therapy can be expected to be just as successful in the long term, e.g., with a "stork bite" or small, non-growing hemangiomas in cosmetically unproblematic body regions. The treatment of these changes using IPL technology is not part of the GKV catalog of services, but there are various alternative treatment options available, which are usually covered by statutory health insurance. In addition to contact cold therapy, pulsed dye lasers and other laser systems with vascular effects are particularly worth mentioning here. Larger hemangiomas, especially with extensive subcutaneous parts and so-called cavernous hemangiomas, require additional Nd:YAG laser therapy in order to reach the deeper parts safely.

In principle, the same applies to acquired vascular anomalies as to congenital anomalies. Here, too, even large areas can be effectively treated with IPL technology with few side effects. Spider nevi and senile angiomas up to extensive rosacea (Fig. 16.3) and erythrosis interfollicularis colli can be treated as well as progressive disseminated telangiectasias or fine spider veins. Depending on localization, underlying disease, and aggravating risk factors, limited therapeutic success or relapses are possible—as with other laser therapy in these cases. The patients should be informed about this in detail before the therapy.

In the treatment of pigmented skin changes, all lesions that are darker in color than the surrounding skin can ultimately be treated from the physical-technical point of view.

The exact diagnosis of pigmented lesions is particularly important prior to therapy!

In any case, only safe benign skin changes should be treated. Since the possibility of histological examination is not primarily necessary in IPL therapy or laser therapy and is not desired, the exact diagnosis by the dermatological specialist, e.g., by means of reflected light microscopy, is always necessary. Nevus cell nevi and unclear pigmented lesions should be protected from any kind of light exposure and should therefore not be treated directly or indirectly (e.g., during epilation).

In the case of photoepilation using IPL, the determination of the causes is also a central component of preparation and treatment. Hormonal, medicinal, or other unfavorable influences on hair growth should be determined and eliminated as far as possible in advance of treatment. Close cooperation with the gynecologist in charge of the hirsute patient is highly recommended. The effectiveness of epilation also depends on the pigment content of the hair: white hair can only be treated with difficulty or not at all effectively. In addition, the **hair growth cycle** and the depth of the hair follicle to be treated affect the success of treatment. Since laser and IPL epilation can only ever be effective on growing hair in a certain growth phase, the so-called anagen phase, areas with a high anagen rate (e.g., beard area and head hair) are particularly suitable for treatment. Areas with a low anagen rate (e.g., forearms or back) require other therapy concepts with longer treatment intervals. In addition, many treatment sessions are often necessary in these areas with IPL systems.

An important criterion for every treatment with flashlamp systems (and numerous lasers) is the **skin type** of the patient. Tanned or dark-skinned individuals should be treated significantly milder and more carefully, if at all, than light-skinned individuals. The pigment embedded in the skin absorbs the applied light energy much more strongly than light-colored skin, so side effects such as skin redness, crusts, blisters, or discolorations are more likely to be expected in dark-skinned or tanned patients.

Therefore, any kind of UV exposure should be avoided at least 4 weeks before IPL therapy, as should "self-tanning" and medications (St. John's wort, ibuprofen, antibiotics, etc.) and foods that increase light sensitivity.

In summary, the optimal procedure is a detailed discussion, including the diagnosis, type, extent, timing, and course of the planned treatment, posttreatment, temporary and permanent damage and possible alternative methods, the number of treatment sessions required, and the expected costs.

Ideally, especially in the case of extensive interventions, the consultation does not take

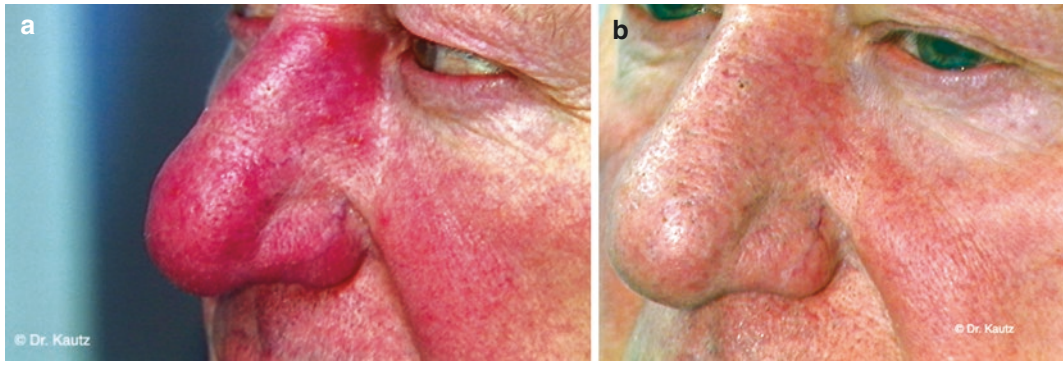

Fig. 16.3 (**a**, **b**) Rosacea of the nose: (**a**) before and (**b**) after an IPL therapy

place on the same day as the treatment itself, as this gives the patient time to make his decision without time pressure and without the psychological stress of the forthcoming intervention.

Trial treatments (e.g., on a small area of skin, hidden parts of the body) are particularly recommended for the planned treatment of large areas or exposed body areas in order to evaluate success, accompanying reactions, and expected side effects.

However, the implementation of a trial therapy does not guarantee that the subsequent treatments will run smoothly. All setting parameters must be checked again before each therapy.

Treatment Procedure

Before the actual treatment, all pigmented exteriors (makeup, etc.) in the treatment areas must be thoroughly removed. Immediately before the treatment, a clear, translucent gel (cooled if necessary), e.g., ultrasound gel, is applied. The patient's eyes should be closed during treatment and provided with light protection (e.g., laser safety goggles or eye-pads approved for IPL). The practitioner, like all persons in the treatment room, must wear suitable protective glasses. Even if it is not a laser in the physical sense, all safety regulations applicable to lasers should be observed when using IPL technology. Depending on the indication and the skin type of the patient, the dentist enters or checks the parameters suitable for the treatment before the therapy.

Cooling the regions to be treated before and during treatment can significantly improve unwanted sensations.

However, it must be ensured that too much precooling can reduce the effectiveness, e.g., by vascular contraction in vascular lesions! Different **cooling systems** during and after the treatment, however, have been proven to reduce the sensation of pain as well as the possible aftereffects. Patients usually describe a short bright flash of light and a slightly burning pain during IPL treatment. The brightness of the light and the associated short fright are usually more unpleasant than the discomfort on the skin. In more than 95% of cases, treatment without any local anesthetic or other painkillers is well tolerated and rated 4–5 on a pain scale of 1–10. Due to the strongly subjective opinion of the individual in the perception of pain, however, the entire spectrum of the reactions expressed ranges from "completely harmless" to "absolutely unbearable." This is where the **trial treatment** is expedient, in order to take appropriate pain-relieving measures (e.g., Emla® cream, ELA-MAX®, Pliaglis® cream, etc.).

The treatment takes between 5 and 30 min, depending on the extent of the areas to be removed. After the treatment, a slight redness and swelling often occur, which can be significantly reduced by after-cooling the treated areas.

Posttreatment

A common temporary immediate reaction is reddening or slight swelling, which can last up to

48 h after treatment. This redness that occurs after the treatment as well as small bluish superficial bruises can be covered immediately with makeup. The patient can usually immediately participate in everyday life again.

The success of the individual treatment can be assessed after 3–4 weeks. At the earliest then the next treatment of the same skin area should take place. The avoidance of sunlight 4 weeks before and after treatment is recommended. If the sun cannot be avoided in summer, the daily use of a sun cream with a high sun protection factor makes sense.

Since in most cases several treatments are necessary, it makes sense to draw up an overall treatment concept and a close patient management. If necessary, skin type advice and information about behavior in the sun should be provided. The patient should receive information on the long-term care and therapy of his skin and skin disease. Many of these skin diseases—despite IPL treatment—tend to relapse, so patients should be checked in at regular intervals.

16.5 Side Effects

Rare side effects are skin reactions similar to burning, such as crusts, blisters, persistent swelling, and the resulting temporary light or dark coloration (hyper- or hypopigmentation) of the skin, which can last up to several weeks. Externally applied medium-strong, cortisone-containing exteriors (e.g., Advantan cream or Fucicort cream) may contribute to accelerated healing in this phase.

As long as the mentioned side effects and aftereffects are present, however, consistent light protection should continue to be applied.

16.6 Contraindications

Skin pigments that cannot be clearly diagnosed as age spots, freckles, or simple pigmentation and all other skin changes of unclear dignity should not be treated with IPL or a laser but should be operated on and examined for fine tissue.

Pregnant women should generally not be treated with IPL or laser, even if from a medical point of view there is no danger for the unborn life.

Very dark pigmented skin types (Fitzpatrick grade 4–6) can also be treated with IPL but require a certain routine and experience in IPL therapy. Currently tanned patients should not be treated. Contraindications are also existing florid skin infections (e.g., fresh herpes). Patients with an increased risk of scarring (keloid tendency) or a generally poor healing tendency, e.g., in diabetes, and patients with an increased tendency to bleed, e.g., when taking Marcumar, are also less suitable for IPL treatment. In these cases, a therapy decision must be made after careful consideration of the findings. If light sensitizing substances are ingested, they should also not be treated. Unsuitable indications are also larger-volume vessels or spider veins, unless all the necessary thicker lateral veins and nutritional vessels have been removed in advance by surgery or sclerotherapy.

16.7 Necessary Equipment for Operating IPL Systems

For safety reasons, the same standards should apply to the acquisition and commissioning of IPL devices as to the use of Class 3–4 medical laser systems. Before the initial commissioning of lasers, the operator of Class 3B and Class 4 laser systems must provide a **laser safety officer** can be ordered. This can be the operator himself or an employee. A person is considered to be competent if he has acquired sufficient knowledge of the equipment to be used on the basis of technical training or experience and is thoroughly informed about the effect of the laser radiation, the protective regulations, and necessary protective measures. In addition, it is necessary to complete a course recognized by the employers' liability insurance association and held in accordance with the relevant guidelines in order to obtain expertise as a laser representative.

According to § 7 of the MPBetreibV, each laser used in medicine must be equipped with a so-called "laser" medical products book with the following information and measures: name and other data for identification of the laser system, proof of

functional test and instruction, name of the laser officer, date of instruction and name of the persons instructed, deadlines and date of execution as well as the result of safety and metrological checks and date of maintenance as well as name of the person/company responsible for this, date, type and consequences of malfunctions, and repeated similar operating errors. (This is especially important when purchasing used equipment!)

With the **acquisition cost** of the IPL devices, there are high price differences due to the meanwhile large offer by numerous companies. Used equipment can be purchased as well as new equipment with several "treatment heads" and integrated laser systems or equipment with a combination of IPL technology with radio frequency technology. The duration of the warranty period is important for the purchase, as is the possible "number of shots per treatment head"; the conclusion of maintenance contracts must also be reconsidered at the time of purchase. Due to the high variance and rapid market changes, prices cannot be quoted here.

A sensible additional investment for extensive, frequent treatments is a **cooling unit** for cold air cooling of the treated areas. Initially, simple contact cooling methods such as cooled treatment gel, moisturization of the skin (evaporative cooling) after therapy, or cooled gel cushions are sufficient.

For the treatment itself, there should be a treatment room equipped with laser safety technology and appropriately marked with a treatment couch.

Photodocumentation should be available to ensure appropriate clinical documentation before and after IPL (and laser) therapy.

16.8 Combination of IPL Devices with Other Laser Systems Using the Example of M22™

The M22™ is a modular multi-application platform for the treatment of dermatologically and aesthetically indicated indications and for hair removal. The platform so far comprises three treatment effective high-tech modules: IPL, Nd:YAG, and ResurFX (Fig. 16.4). The system can thus be adapted to the needs of a practice. In addition, the user has a choice of more than 1000 preset treatment parameters at his disposal. With increasing treatment experience, the user can select his own parameters. Therefore, the M22™ is ideal for entering the world of light- and laser-based treatments.

The three modules are in detail:

Universal IPL™ with Optimal Pulse Technology (OPT™) (Table 16.1)

The IPL handpiece is equipped with six expert filters (Fig. 16.4) tailored to the indications to be

Table 16.1 Universal IPL™ with Optimal Pulse Technology (OPT™)

Technical data	Universal IPL handpiece with six ExpertFiltern™ (515, 560, 615, 640, 695 nm), two SapphireCool™ light guides (35 × 15 mm and 15 × 8 mm), and Optimum Pulse Technology (OPT™) Energy density 10–35 J/cm^2, pulse duration 4–20 ms, pulse delay 5–150 ms Pulse characteristics: adjustable pulse sequence, repetition rate up to 1 Hz, constant contact cooling
Indications	Twenty-three indications, e.g., pigmented lesions, vascular lesions, hair removal, dyschromias

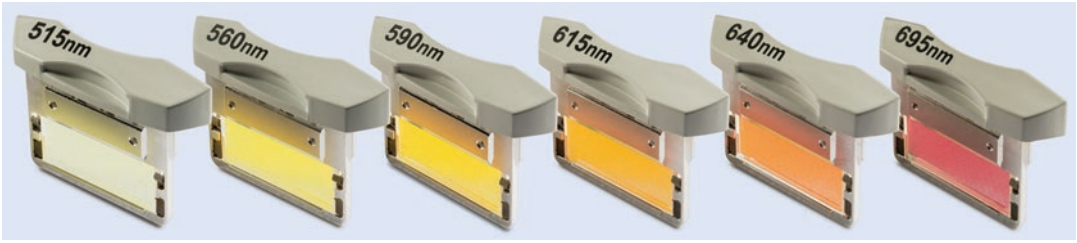

Fig. 16.4 ExpertFiltern™ at 515, 560, 615, 640, and 695 nm (© Lumenis)

treated and features computer-controlled filter recognition for increased safety and ease of use.

Thanks to the universal IPL handpiece with FDA approval, the "ExpertFiltern" can be replaced in seconds. This saves not only treatment time and storage space but also considerable costs. Instead of several handpieces, as with most other suppliers, the M22™ only needs one IPL handpiece to enable effective treatments. Multiple SapphireCool light guides for large and small areas maximize patient comfort through continuous contact cooling.

Multi-Spot™ Nd:YAG (Table 16.2)

The Nd:YAG module with FDA approval of M22™ offers the treatment of telangiectasias, hemangiomas, leg veins, and facial wrinkles. The multisequential pulse sequence, which is available for both the Nd:YAG and IPL modules of M22™, allows cooling between pulse sequences to protect the epidermis while allowing the safe use of high fluences. This allows the safe treatment of all skin types, including dark skin, and reduces the risk of unwanted side effects.

ResurFX™ (Fractionating, Non-Ablating Laser Handpiece for the Treatment of Striae, Wrinkles, and Scars)

The ResurFX module for M22™ currently offers the only true fractionated non-ablative technology. ResurFX uses a 1565 nm fiber laser and a state-of-the-art CoolScan scanner for nonsequential scanning. The algorithm used places each fractionated point in a controlled manner to protect the tissue from heat buildup and overheating. In addition, the scanner allows you to choose from over 600 combinations of shapes, sizes, and intensities to achieve optimal treatment results.

The ergonomic ResurFX handpiece features continuous contact cooling to enhance patient comfort during treatment. Indications are acne scars, surgical scars, dyschromias, periorbital wrinkles, striae, and skin resurfacing.

Table 16.2 <font color="#ffff00">- = Spot™ = - proudly presents

Technical data	1064 nm Neodymium:YAG module with two SapphireCool™ light guides (6 mm and 2 × 4 mm) and multisequential pulse sequence Energy density 20–225 J/cm^2, pulse duration 2–20 ms, pulse delay 5–100 ms Pulse characteristics: adjustable pulse sequence, repetition rate up to 1 Hz, constant contact cooling
Indications	Vascular lesions, hemangiomas, leg veins, telangiectasia, wrinkles

16.9 Evaluation of the Medical-Therapeutic Results for the Individual Indications

As is the case with all laser and lighting technologies, IPL technology is first and foremost based on the principle: indication before application! Unfortunately, the high purchase costs of equipment in particular tempt people to carry out unnecessary or even risky treatments in order to "reinstate" the equipment costs. However, if all criteria are observed in the "preparation phase" before therapy and if the patient is informed fairly and comprehensively about the treatment and its possibilities and risks, IPL technology offers an excellent and safe medical tool. Excellent and reliable therapeutic success is achieved with superficial fine vascular lesions such as rosacea, as well as with epilation. Good to satisfactory therapeutic success can be expected with pigment lesions and acne scars (Fig. 16.5). However, if the treatment spectrum to be expected in practice is limited to individual indications only, other methods (laser/chemical peeling, etc.) may offer more effective and/or less expensive alternatives.

IPL technology offers an advantageously broad spectrum of efficacy with good effectiveness in all indication areas mentioned, especially for "entry into light and laser applications." As with laser technology, however, a high degree of preparation, training and education is necessary for the treating physician, with high investment costs overall. The exact knowledge of the skin

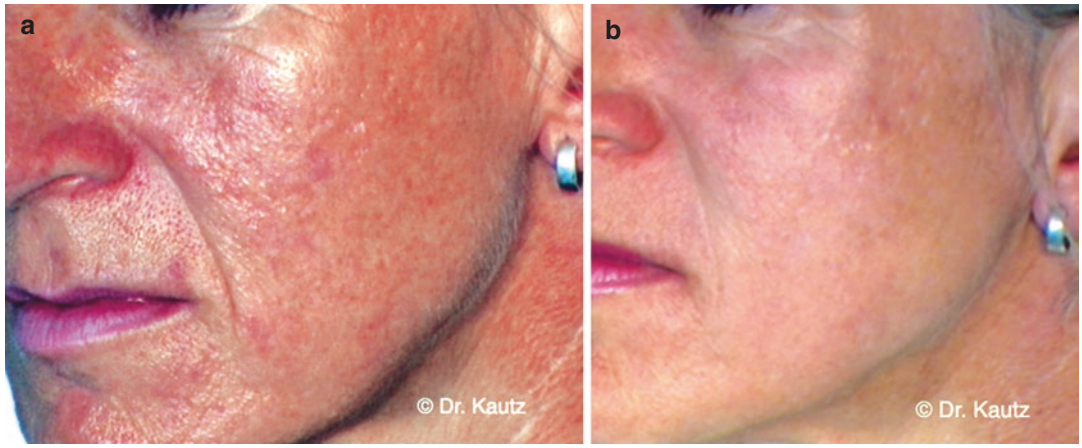

Fig. 16.5 Acne scars (**a**) before and (**b**) after IPL therapy

and its structures, diseases, and treatment options is indispensable, as the IPL technique alone is not sufficient in many cases, but an adequate medical pre- and posttreatment makes sense. An advantage of the IPL technique is its outpatient use, the possibility of treating even large areas of the skin in a relatively short time, and the very low side effects (*no down time* for the patient).

Hospitations, courses and trainings, partly with integrated laser safety courses and "hands-on training" are offered by various sales companies. In addition, appropriate courses or satellite symposia are now held at all dermatological advanced training congresses. The German Dermatological Laser Society (DDL) (www.ddl.de) provides information on this subject.

Conclusion

IPL technology offers an advantageously broad spectrum of efficacy with good effectiveness in all indication areas mentioned, especially for "entry into light and laser applications." As with laser technology, however, a high degree of preparation, training, and education is necessary for the treating physician, with high investment costs overall. The exact knowledge of the skin and its structures, diseases, and treatment options is indispensable, as the IPL technique alone is not sufficient in many cases, but an adequate medical pre- and posttreatment makes sense. An advantage of the IPL technique is its outpatient use, the possibility of treating even large areas of the skin in a relatively short time, and the very low side effects (*no down time* for the patient).

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Suggested Reading

Angermeier MC. Treatment of facial vascular lesions with intense pulsed light. J Cutan Laser Ther. 1999;1(2):95–100.

Bitter PH. Noninvasive rejuvenation of photodamaged skin using serial, full-face intense pulsed light treatments. Dermatol Surg. 2000;26(9):835–42.

Clark SM, Lanigan SW, Marks R. Laser treatment of erythema and telangiectasia associated with rosacea. Lasers Med Sci. 2002;17(1):26–33.

Fodor L, Ramon Y, Fodor A, Carmi N, Peled IJ, Ullmann Y. A side-by-side prospective study of intense pulsed light and Nd:YAG laser treatment for vascular lesions. Ann Plast Surg. 2006;56(2):164–70.

Goldberg DJ. New collagen formation after dermal remodeling with an intense pulsed light source. J Cutan Laser Ther. 2000;2(2):59–61.

Kautz G, Cremer H (Hrsg.). Hämangiome. Heidelberg: Springer; 1998.

Kautz, et al. Hämangiomtherapie mit dem Photoderm®. In: Dermatologie an der Schwelle zum neuen Jahrtausend. Heidelberg: Springer; 1999. p. 702–4.

Kautz G, Rick K, Sandhofer M (2004) Photoepilation neuester Stand. Steinkopff-Verlag

Konishi N, Kawada A, Kawara S, Oiso N, Endo H, Yoshinaga E, Momma T. Clinical effectiveness of a novel intense pulsed light source on facial pigmentary lesions. Arch Dermatol Res. 2008;300(Suppl 1):S65–7.

Lask G, Eckhouse S, Slatkine M, Waldman A, Kreindel M, Gottfried V. The role of laser and intense light sources in photo-epilation: a comparative evaluation. J Cutan Laser Ther. 1999;1(1):3–13.

Li G, Lin T, Wu Q, Zhou Z, Gold MH. Clinical analysis of port wine stains treated by intense pulsed light. J Cosmet Laser Ther. 2010a;12(1):2–6.

Li YH, Wu Y, Chen JZS, Zhu X, Xu YY, Chen J, Dong GH, Gao XH, Chen HD. A split-face study of intense pulsed light on photoaging skin in Chinese population. Lasers Surg Med. 2010b;42:185–91.

Ma G, Lin XX, Hu XJ, Jin YB, Chen H. Treatment of venous infraorbital dark circles using a long-pulsed 1,064nm neodymium-doped yttrium aluminum garnet laser. Dermatol Surg. 2012;38:1277–82.

Prieto VG, Sadick NS, Lloreta J, Nicholson J, Shea CR. Effects of intense pulsed light on sun-damaged human skin, routine, and ultrastructural analysis. Lasers Surg Med. 2002;30(2):82–5.

Raulin C, Greve C. Laser und IPL-Technologie in der Dermatologie und Ästhetischen Medizin. Stuttgart: Schattauer; 2003.

Sasaya H, Kawada A, Wada T, Hirao A, Oiso N. Clinical effectiveness of intense pulsed light therapy for solar lentigines of the hands. Dermatol Ther. 2012;24:584–6.

Troilius A, Troilius C. Hair removal with a second generation broad spectrum intense pulsed light source—a long-term follow-up. J Cutan Laser Ther. 1999;1(3):173–8.

Zaleski L, Fabi S, Goldman MP. Treatment of melasma and the use of intense pulsed light: a review. J Drugs Dermatol. 2012;11(11):1316–20.