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IPL Technology: A Review

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Background and Objectives: Intense pulsed light (IPL) systems are high-intensity light sources, which emit polychromatic light. Unlike laser systems, these flashlamps work with noncoherent light in a broad wavelength spectrum of 515–1,200 nm. These properties allow for great variability in selecting individual treatment parameters and adapting to different types of skin types and indications. The purpose of this article was to critically review international medical publications of the many indication in which IPL technology can be used, including our own evaluations and experiences.
Study Design/Materials and Methods: The range of therapeutic uses for high-intensity flashlamps was reviewed, ranging from benign cavernous hemangiomas, benign venous malformations, essential telangiectasias, leg telangiectasias, poikiloderma of Civatte, and port-wine stains to pigmented lesions, cosmetically undesired hypertrichosis, and facial rhydids. The relative benefits and risks were discussed in detail and compared with other laser systems.
Results: Because of the wide spectrum of potential combinations of wavelengths, pulse durations, pulse frequency, and fluences, a great deal of experience is required when using IPL technology. Proper patient selection and critical diagnostics serve to keep the adverse effects of the treatment to a minimum.
Conclusions: The distinctive technical conditions involved combine to make IPL technology an alternative and auxiliary treatment option to existing laser systems and conventional therapies. Lasers Surg. Med. 32:78–87, 2003. © 2003 Wiley-Liss, Inc.

Key words: intense pulsed light systems; IPL technology; lasers

INTRODUCTION

In 1976, Muhlbauer et al. first described the thermocoagulation of capillary hemangiomas and port-wine stains by means of polychromatic infrared light [1]. In the 70s and 80s, there were only a few articles about treating vascular malformations and tattoos with polychromatic, noncoherent light [2–4]. In 1990, Goldman and Eckhouse began developing new high-intensity flashlamps for treating vascular anomalies of the skin; the first market-ready system that was based on IPL technology, PhotoDerm® VL (Lumenis Ltd., Yorkneam, Israel), became available in 1994. This was followed by a series of further developments and innovations in the past 8 years, and as a result, the spectrum of possible indications has also increased greatly [5].

Biophysical Interactions

Intense pulsed light (IPL) systems are high intensity pulsed sources which emit polychromatic light in a broad wavelength spectrum of 515–1,200 nm. The mechanism of action of such light systems corresponds to the selective photothermolysis that Anderson and Parrish described for the pulsed dye laser [6]. Because of the varying absorption maximums of the respective target structures, appropriate wavelengths can be selected to deliberately heat (>80°C) and destroy them. Hemoglobin primarily absorbs at a wavelength of 580 nm; melanin takes in the entire visible spectral range (400–750 nm) [7].

The wavelength determines not only the absorption behavior but also the penetration depth of the light. In the visible spectral range, the latter increases with the wavelength. With the aid of different cut-off filters (515–755 nm), which only allow a defined wavelength spectrum to penetrate, the optimal wavelength spectrum can be filtered out to correspond to the depth of the target structure (vessels of different depths and sizes, hair follicles, pigmented structures) [7,8]. Similarly, the wavelength can be adapted to the patient's individual skin type, since higher filters reduce the absorption of melanin and can thus be used to prevent strong adverse effects such as severe erythema, blistering, and crusting in those with darker skin types [7,9].

The pulse duration of IPL systems can be set to ranges between 0.5–88.5 milliseconds and should be lower than the thermal relaxation time of the target structure so that the surrounding tissue is not damaged [8,10,11]. The use of single pulses is possible, and high fluences can be split into multiple pulses as well; the intervals between the individual pulses can be set at values between 1 and 300 milliseconds. This delay allows the epidermis cells and smaller vessels to cool down between pulses while the heat is retained in the larger (target) vessels/hair follicles,

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TABLE 1. Kinds of Devices

	PhotoDerm®	EpiLight™	VascuLight™ SR, HR, VX, DL	AestiLight™	IPL™ Quantum HR	IPL™ Quantum SR	Ellipe relax light	Aurora® DS	Aurora® SR
Source of light	IPL	IPL	IPL/Nd:YAG	IPL	IPL	IPL	IPL	IPL/RF	IPL/RF
Spectrum (nm)	515–1,200	590–1,200	515–1,200/1,064	645–1,200	695–1,200	560–1,200	400–950	680–980	580–980
Optical filter (nm)	515/550/570/590/615/645/695/755	590/615/645/695/755	515/550/560/570/590/615/640/645/695/755	Factory setting	645, 755	560, 590, 640	600–950, 550–950, 400–720		
Fluence (J/cm^2)	3–90	20–65	3–90/40–150	24–32	Pre-programmed settings	Pre-programmed settings	21–23		
Pulse sequence	1, 2, 3	2, 3, 4, 5	1, 2, 3	3			1–7		
Pulse duration (milliseconds)	0.5–25	2.5–7	0.5–25/2–16	Factory setting			0.5–88.5	7–100/to 200	7–100/to 200
Pulse delay (milliseconds)	1–300	1–300	1–300/1–300	Factory setting			1.5–127		
Spot size (mm^2)	120, 280	280, 450	120, 280/29	200	272	272	480;51	300	300
Fluence ($J/cm^2/J/cm^3$)								10–30/5–20	10–30/5–20
Pulse repeat rate								0.7 pps	0.7 pps
Frequence of RF energy (MHz)								1	1

resulting in selective thermal damage (the principle of thermokinetic selectivity) [7,10]. The extent of the maximum fluences and the size of the spot size vary, depending on the kind of equipment used (Table 1).

Adverse Effects and Concomitant Reactions

Unfortunately, to date only few studies have thoroughly documented adverse effects and complications. The most commonly cited postoperative concomitant reaction was a routinely occurring transient erythema, which lasts for 2–48 hours and is occasionally accompanied by edema. Most patients stated that depending on the fluence used, they felt sensations of burning or puncturing during treatment. In most cases, topical anesthesia is not necessary. After the administration of high fluences and short pulse times, there have been reports of transient purpura, crusting, and hyper- and hypopigmentation; this is most often observed in patients with dark skin types or tanned skin. The painfulness of treatment also increases with higher fluences and shorter pulses. Treating hypertrichosis by IPL technology leads to transient crusting, blisters, and hypopigmentation more frequently than in other indications. Scarring, necrosis, and permanent changes in pigmentation should not occur if the equipment is utilized correctly [7–9,12–14]. In their 2001 trial, Miyake et al. examined the changes in skin temperature during treatment of varicose leg telangiectasias by means of high-intensity flashlamps and also studied the adverse effects that occurred post-treatment. Among other things, they concluded that there were many factors in addition to the skin type and degree of tanning that had major effects on the prevalence of side effects: skin tone, thickness of the dermis, the degree of sensitivity, and the relative number of sebaceous glands on various parts of the body. This is why treatment parameters should not be standardized but determined on a case-by-case basis, even among patients with the same skin type. If necessary, multiple sample treatments should be performed [15]. Furthermore, the skin must be sufficiently cooled during treatment to protect the epidermis from being burned; the cooling can be performed using cooling gels, ice gels, contact spray cooling, or special cooling handpieces [16,17].

BENIGN VASCULAR LESIONS

The exact therapeutic parameters, number of patients and treatment sessions, and results are shown in Table 2.

Benign Venous Malformations

Deep benign venous vascular anomalies can generally be treated by means of surgery, sclerotherapy treatment, high doses of corticosteroids, and with the Nd:YAG laser (percutaneously or interstitially) [7]. These methods are often restricted by the adverse effects of treatment and by the extent of the malformation, the size or depth of the vessel, and localization of lesions. Pulsed and long-pulsed dye lasers, long-pulsed Nd:YAG lasers, and cryotherapy, all of which have demonstrated good results in treating initial superficial hemangiomas, are not ideal for treating

TABLE 2. Treatment Parameters

Author	Lesion	Number of patients	Number of treatments	Cut-off filter (nm)	Pulse-mode	Pulse duration (milliseconds)	Pulse-delay (milliseconds)	Fluence (J/cm^2)	Clearance
Raulin et al. [18]	Venous malformations	2	3–11	570, 590	2, 3	Not stated	Not stated	40–77	One patient: complete; one patient: good
Raulin et al. [19]	Venous malformations	11	<100 cm^2: 2–7; >100 cm^2: 18	550, 570, 590	1, 2, 3	2.5–8.7	Not stated	32–90	Seven patients: 85–100%; four patients: 70–84%
Maushagen-Schnaas et al. [20]	Venous malformations	9	10	515, 550, 570, 590	1, 2, 3	0.5–25	10–500	3–90	Cosmetically satisfactory
Angermeier [23]	Essential telangiectasias	153	1–4	550, 570	2	2.5–6.0	20–30	36–45	75–100%
Schroeter et al. [24]	Essential telangiectasias	45	1	550, 570, 590	1, 3	2.6–5	10–20	30–50	90–95%
Raulin et al. [25]	Essential telangiectasias	14	1–10	515, 550, 570	1, 2	3–5	Not stated	21.5–42	Thirteen patients: 75–100%; one patient: 60%
Angermeier [23]	Hemangiomas	45	1–4	50, 570, 590	3	2.5–6	20–30	36–45	75–100%
Weiss et al. [28]	Poikiloderma of Civatte	135	3	515, 550, 570	1, 2	2–4	10	20–24	One hundred eleven patients (82%): 75–100%
Goldman et al. [29]	Poikiloderma of Civatte	66	Mean 2.8	515, 550, 570	2	2–4	10	30–34	50–75% improvement
Schroeter et al. [24]	Poikiloderma of Civatte	15	1	515, 550	1	2.5–3	0	22–26	90% in vascular part
Raulin et al. [36]	Port-wine stains	37	Mean number: 2.9 ± 2.87–4.0 ± 1.87	515, 550, 570	1, 2, 3	2.5–5	Not stated	20–70	70–100%
Goldman et al. [5]	Leg telangiectasias	159		550, 570, 590	1, 2, 3	2.4–6	10–30	22–60	90%Ø <0.2 mm; 80%Ø 0.2–1 mm
Schroeter et al. [43]	Leg telangiectasias	40		515, 550, 570, 590	1, 2	3–6	20–50	20–70	92.1Ø <0.2 mm; 80%Ø 0.2–0.5 mm; 81%Ø 0.5–1 mm
Sadick [44]	Leg telangiectasias	50	1–3	550 cut-off filter 1064nm Nd:YAG-Laser	2 1	2.4/4.6 14.0	20 —	40 140	80% significant clearing of 75–100%
Green [45]	Leg telangiectasias	72	1–5	515, 550, 570, 590	2, 3	2.6–7.7	10–100	25–70	9.5% almost complete to complete clearance
Bjerring et al. [46]	Solar lentigines, melanocytic nevi	26	1	Emitted wavelength 400–720 nm	2	7	25	10–20	Lentigo solaris 74.2%; melanocytic nevi 66.3%
Kawada et al. [47]	Solar lentigines, ephelides	60	3–5	560	2, 3	2.6–5.0	20	20–24	Improvement: 48% of patients >50%; 20% of patients >75%

TABLE 2. (*Continued*)

Author	Lesion	Number of patients	Number of treatments	Cut-off filter (nm)	Pulse-mode	Pulse duration (milliseconds)	Pulse-delay (milliseconds)	Fluence (J/cm^2)	Clearance
Schroeter et al. [49]	Hair	40	2–13	Parameters highly varied					Reduction of 76.7%
Gold et al. [12]	Hair	31	1	590, 615, 645, 690	2–5	1.5–3.5	20–50	34–55	60% hair removal
Weiss et al. [13]	Hair	71	1–2	615, 645	3	2.8–3.2	20–30	40–42	33–63% hair reduction
Troilus et al. [57]	Hair	10	4	Emitted wavelength 600–950nm	4	10	1.5	Mean 18.3	74.7–80% hair reduction
Sadick et al. [58]	Hair	34	1–7	615, 645, 695	2, 3	2.6–3.3	30–40	43–42	76–83% efficacy in hair removal
Goldberg et al. [59]	Rhytids	30	1–4	645	3	7	50	40, 50	Five patients: none; 16 patients: some; 9 patients: substantial clinical improvement
Goldberg et al. [65]	Rhytids	15	3–5	590, 755	3	3–7	20–60	40–70	All patients: mild to moderate improvement, no difference between devices
				1,064 nm Nd:YAG	—	3–8	20–30	100–130	
Bitter [61]	Wrinkling, irregular pigmentation, telangiectasias	49	4–6	550, 570	2, 3	2.4–4.7	10–60	30–50	10–90% improvement
Negishi et al. [62]	Wrinkles, pigmentation, telangiectasias	97	3–6	550, 570	2	2.5–4.0, 4.0–5.0	20, 40	28–32	56–100% improvement in skin texture, telangiectasias, pigmentation in 66–91% of patients
Negishi et al. [66]	Wrinkles, pigmentation, telangiectasias	73	5 or more	560	2	2.8, 3.2, 6.0	20, 40	23–27	>60% improvement in skin texture, telangiectasias, pigmentation in >80% of patients
Hernández-Pérez et al. [67]	Photodamage	5	5	570, 645	Not stated	2.4–7.0	20	25–45	Moderate to very good improvement

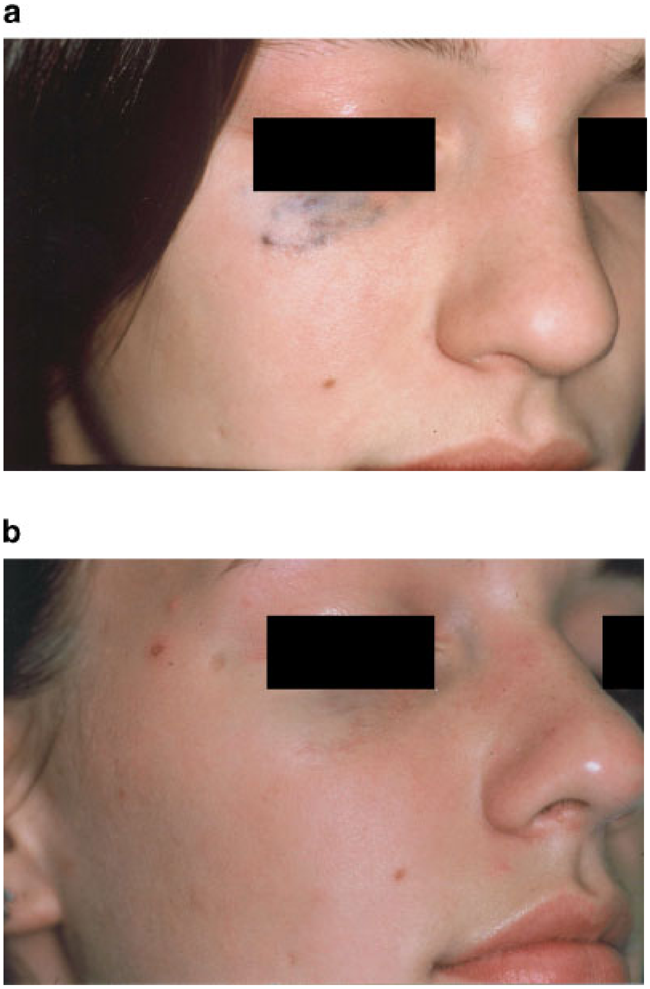

Fig. 1. **a**: Venous malformation in a 13-year-old female patient; (**b**) results 4 months after eight sessions with the PhotoDerm® VL.

venous malformations because their penetration is too shallow [7]. IPL systems, on the other hand, are the preferred method of treatment in this case (Fig. 1a,b).

In the course of three trials, we studied a total of 22 patients with venous vascular anomalies on the face, neck, torso, legs, penis, and scrotum. After 1–10 treatments with PhotoDerm VL, 11 patients showed excellent to good clearance; after an average of 10 sessions, 10 patients had cosmetically satisfactory results, and one patient experienced complete remission after only four sessions [18–20].

Essential Telangiectasias

Teleangiectasias on the nose and cheeks present a significant cosmetic problem for many patients. Older forms of treatment such as electric cauterization with a diathermy needle or sclerotherapy treatment not only entail severe adverse effects but are also much less widely used due to the much more effective therapeutic options of laser and IPL technology [7]. With the pulsed 0.5 milliseconds dye laser, which is still the preferred method of treatment, very good results are achievable. However, the intracutaneous hematomas that occurred post-treatment are a complication that many patients would not tolerate well [7,21]. For this reason, IPL systems have been growing increasingly widespread in treating essential telangiectasias over the past years (Fig. 2a,b). The high success rates and low occurrences of adverse effects have been confirmed in several publications [8,9,22].

For example, Angermeier treated 153 patients with essential telangiectasias using PhotoDerm VL. After one to four sessions, the clearance rate totaled 75–100% [23].

Schroeter et al. also achieved a clearance rate of 90–95% after a single session with PhotoDerm VL in 45 patients with essential telangiectasias and spider nevi [24].

We reported a good to excellent clearance rate in 13 of 14 patients after 1–10 sessions with PhotoDerm VL [25].

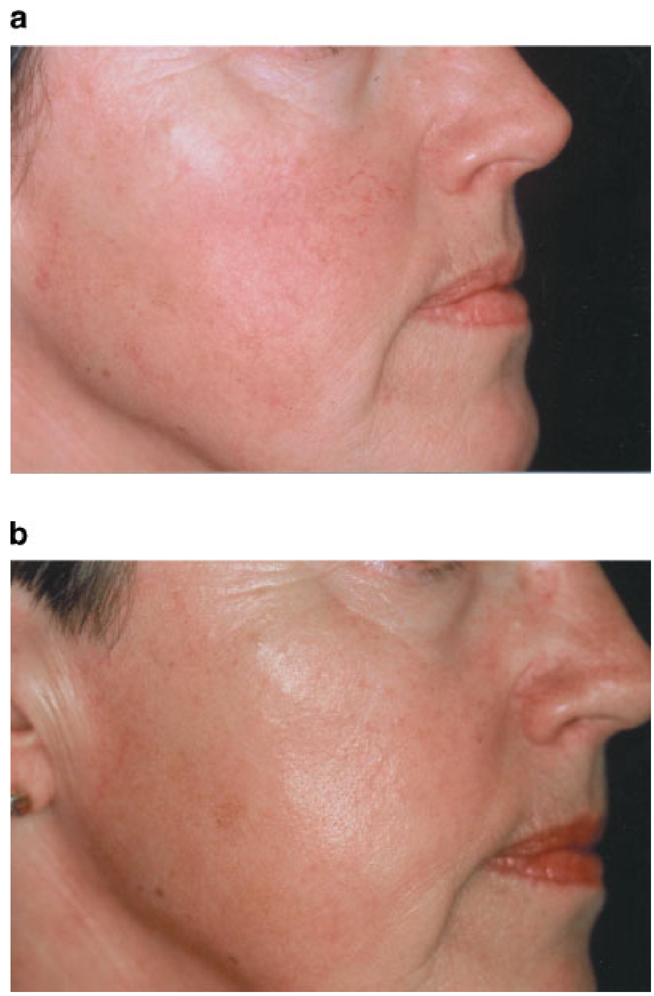

Fig. 2. **a**: Marked telangiectasias on a 55-year-old patient with rosacea; (**b**) results 3 months after five sessions with the PhotoDerm® VL.

Hemangiomas

Hemangiomas frequently demonstrate a great tendency to grow in the first months of life. Although a significant number of such lesions regress, they may continue to expand significantly; in 20% of patients they remain unchanged. This is the reason why treatment should begin as soon as possible. Therapeutic tools include contact cryotherapy, pulsed dye lasers, percutaneous or interstitial Nd:YAG lasers, the long-pulsed KTP-Nd:YAG laser, and various IPL systems; the latter in particular offers many options in selecting parameters (Fig. 3a,b) [7,8,23, 26,27].

a

b

Fig. 3. **a**: Multiple hemangiomas on the dorsum of a 10-month old infant; (**b**) results 8 weeks after a single session with the PhotoDerm® VL (reproduced with the kind permission of Dr. med. G. Kautz, Konz, Germany).

Angermeier, for example, reported a 75–100% clearance rate in 45 patients with centrofacial hemangiomas [23]. Due to the higher numbers of complications and the greater pain levels that are present when IPL technology is used, however, we still regard the pulsed dye laser as the preferred method of treatment for initial superficial hemangiomas [7].

Poikiloderma of Civatte

A uniform resolution of erythema and hyperpigmentation in treating poikiloderma of Civatte can usually be obtained with the 0.5 milliseconds pulsed dye laser. The intracutaneous hematomas that develop post-treatment are esthetically displeasing, however, as is similar in treating essential telangiectasias [7,28,29]. IPL technology provides an alternative.

Weiss et al. succeeded in reaching a clearance rate of 75–100% in 82% of 135 patients after three treatments with PhotoDerm VL [28].

Goldman et al. achieved a 50–75% improvement in the extent of telangiectasias and hyperpigmentation after an average of 2.8 treatments [29].

Schroeter et al. even had clearance rates of 90% in the vascular part in 15 patients [24].

Port-Wine Stains

The pulsed dye laser has proven itself to be the preferred treatment for port-wine stains in both children and adults [30–33]. Lesions with nodular parts and especially hypertrophic and extended port-wine stains may not yield the desired success, however. The reason for resistance to treatment is assumed to be vessels that are too large in diameter or located too deeply [10,34]. In the meantime, long-pulsed dye lasers are available that have variable wavelengths and pulse durations, thus increasing the prospects of progress, even in refractory cases [35].

In a multi-center study, we showed that the PhotoDerm VL generated good results in both therapy-resistant cases as well as in purple and hypertrophic port-wine stains. Thirty-seven adult patients met the inclusion criteria. Overall, complete clearance of pink lesions was possible after an average of four sessions and of red lesions after an average of 1.5. Very dark purple port-wine stains lightened 70–99% after an average of four sessions [36]. Similarly satisfactory results in treating port-wine stains with IPL technology have also been reported by other authors [8,9,23,24,37,38] (Fig. 4a,b).

Leg Telangiectasias

Leg telangiectasias differ most strongly from ectatic vessels in port-wine stains or hemangiomas in that the diameter of the vessel is greater (ø >0.1 mm), the vascular walls are thicker, and the localization is deeper. The necessary conditions for laser or high-intensity flashlamp treatment, therefore, are long wavelengths and long pulse durations [39]. Currently, IPL technology is being used in such cases along with long-pulsed laser systems like Nd:YAG lasers (1,064 nm), KTP-Nd:YAG (532 nm) lasers, Alexandrite lasers, diode lasers, and dye lasers (595/

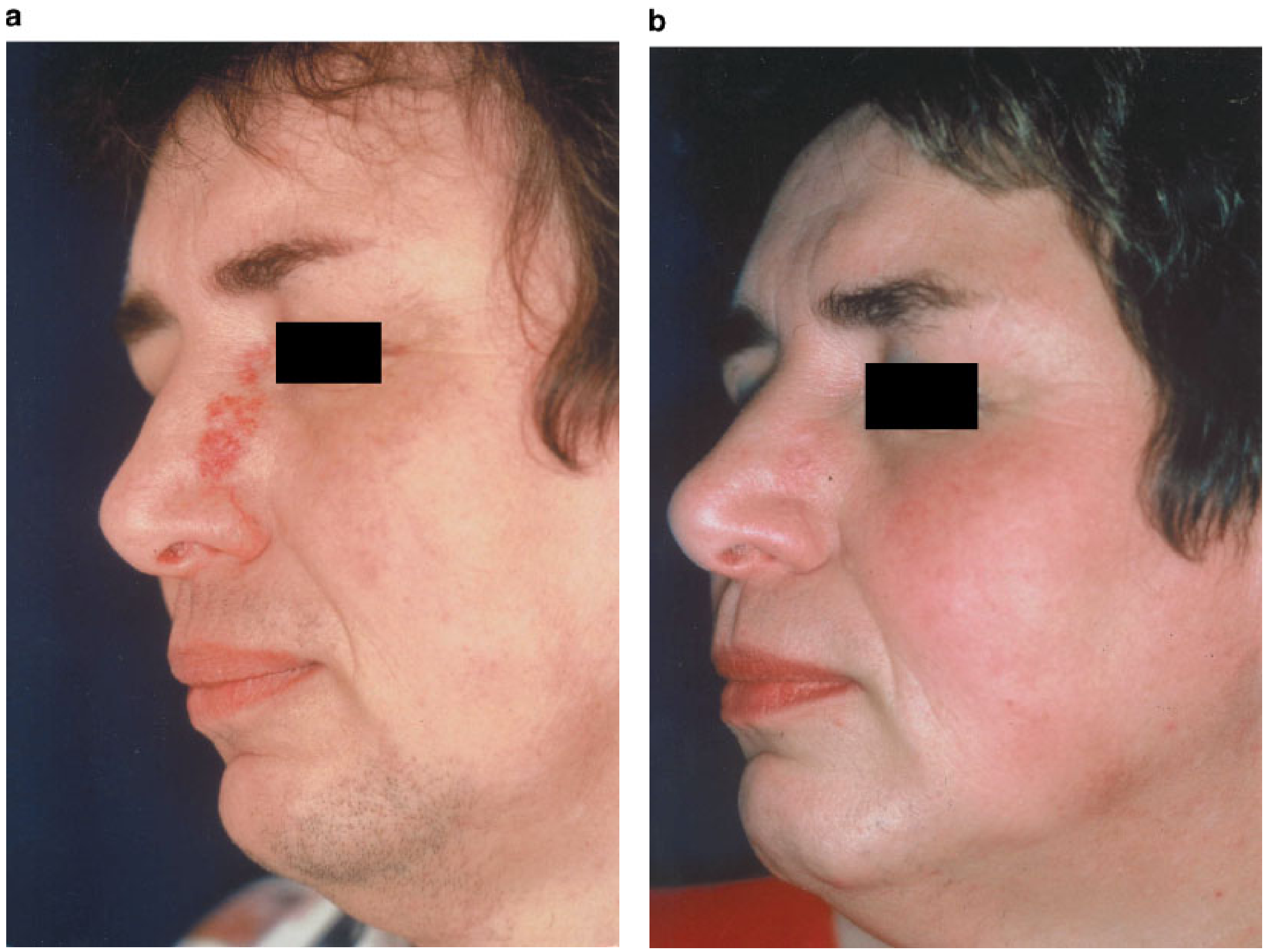

Fig. 4. **a**: Port-wine stain on the left nose present since birth, and marked hypertrichosis on the chin on a 56-year-old female patient; (**b**) results after 7 sessions for the port-wine stain and eight sessions for the hypertrichosis using the PhotoDerm® VL and EpiLight™, respectively.

600 nm) [11,40–42]. Before treatment begins, however, the existence of varicosis must be ruled out, especially as far as the presence of perforating/communicating and feeding veins is concerned. A number of studies with contradictory conclusions have been published about the treatment of leg telangiectasias with IPL technology [8,9,11].

In a multi-center study, Goldman et al. demonstrated a clearance rate of 90% in a total of 159 patients with vessels of <0.2 mm diameter and of 80% in vessels measuring 0.2–1 mm in diameter [5].

Schroeter et al. also observed similar results: clearance rates of 92.1, 80, and 81% in vessels of <0.2, 0.2–0.5, and 0.5–1 mm diameter in their multi-center study of 40 patients [43].

Sadick selected varying wavelengths and devices in his studies of different diameters. Red telangiectasias with a diameter of <1.0 mm were treated with PhotoDerm VL. Blue vessels with a diameter >1.0 mm, on the other hand, were treated with the long-pulsed 1064-nm Nd:YAG-Laser. In 80% of the cases involved, a significant clearance rate of 75–100% was noted 6 months after the end of treatment [44].

Green's results were considerably less promising. Only 9.5% of 72 patients reported complete or almost complete clinical clearing. By contrast, the rate of adverse effects was declared to be unacceptably high (50% hyperpigmentation, 20% hypopigmentation) [45].

Dover et al., Goldman, and Raulin et al. continue to recommend classic sclerotherapy treatment as the "gold standard" for uncomplicated cases of leg telangiectasias; this method has slight adverse effects and little pain. Laser/IPL therapy, on the other hand, is only indicated in therapy-resistant forms, vessels that are very small in diameter, and cases of "matting," a kind of erythema that can occur after sclerotherapy treatment [7,11,39].

PIGMENTED LESIONS

The spectrum of pigmented lesions extends from epidermal lentigines and cafe-au-lait macules to acquired Ota's/Ito's nevus, Becker's nevus and congenital nevi all the way to post-inflammatory hyperpigmentations, melasma, and decorative and traumatic tattoos. Although IPL systems have pulse durations in the millisecond range, which mean that they do not appear to be optimally suited for treating pigmented lesions, there have still been reports of successful use [46,47].

Bjerrring et al. treated a total of 26 patients with solar lentigines and melanocytic nevi using the Ellipse Flex. This IPL device is characterized by the fact that the emitted light is conditioned by two types of optical filters: a hot mirror filter and a water chamber, which work together to create the desired spectral range of light. After a single session, pigment reduction was obtained in 96% of the patients and the average clearance was found to be 74.2% for lentigo solaris and 66.3% for melanocytic nevi [46].

Kawada et al. treated solar lentigines and ephelides. Within three to five sessions, a total of 48% of patients showed a 50% improvement in pigmentation, and 20% even experienced an improvement of 75% [47]. In spite of these promising results, however, q-switched laser systems remain the method of choice for treating benign pigmented lesions.

HAIR REMOVAL

In addition to the treatment of vascular malformations, the treatment of unwanted hair is one of the most important indications for the use of high-intensity pulsed light sources (Fig. 5a,b), even though the exact mechanism of action has not been decisively determined. McCoy et al. state that laser-induced damage to the isthmus and upper stem may interfere with the interaction between dermal and epidermal germinative cells, thus inhibiting or altering the normal hair cycle. By contrast, Schröter et al. and Sadick et al. postulate that damage to the hair follicle and hair shaft in the anagen phase cause a long-term interruption in the hair growth cycle [48–50]. A number of workgroups have demonstrated good results using IPL systems [12,51–56].

In a multicenter study, Schroeter et al. treated 40 patients with excessive facial hair using the PhotoDerm VL. After an average of six sessions and an observation period of 3 months, a reduction of 76.7% was observed [49].

Gold et al. and Weiss et al. included 31 and 71 patients, respectively, with hypertrichosis of different parts of the body. In both instances, the EpiLight™ was selected. After one treatment session and a 3-month follow-up period, Gold et al. reported that an average of 60% of the hair had been removed [12].

Weiss et al. also observed a clearance rate of 64% in one of the study groups after one session and 3 months of follow-up. The second study group showed a clearance rate of only 33% after two photoepilation sessions and twice the follow-up period, six months [13].

Troilius and Troilius examined the efficacy of the Ellipse Relax Light for hair removal in the bikini zone in 11 patients. After four sessions and a follow-up period of four and eight months, the clearance rate rose from 74.7 to 80% [57].

Sadick et al. treated a total of 34 patients with excessive body hair using the EpiLight. The mean hair removal efficiency (HRE) achieved was 76% after a mean of 3.7 treatments. In a subgroup of 14 patients followed-up for more than 12 months (mean 20 months), a final HRE of 83% was achieved after a mean of 3.9 treatments [58].

a

b

Fig. 5. **a**: Hypertrichosis on a 23-year-old transsexual female patient; (**b**) results 2 years after the final of 20 sessions with the PhotoDerm® VL and EpiLight™.

NON-ABLATIVE SKIN REJUVENATION

In recent years, there has been intensive research in the field of non-ablative skin rejuvenation or “subsurfacing”; this comes as a response to the desire for a simple method of treating rhytids caused by aging or UV exposure and actinic aging. Such a method must entail few adverse effects, downtimes that are as short as possible, and not damage the epidermis. In numerous studies, IPL systems and a variety of non-ablative laser devices were used [59–65]. The mechanism of action is supposed to be a selective, heat-induced denaturalization of dermal collagen that leads to subsequent reactive synthesis but does not damage the epidermis.

In their efforts towards non-ablative treatment of facial rhytids using high-intensity flashlamps, Goldberg et al. succeeded in inducing some clinical improvement in 16 and substantial clinical improvement in 9 out of 30 patients [59]. A comparative study between high-intensity flashlamp and 1,064 nm Nd:YAG lasers led to an equally mild to moderate improvement of the skin structure. Differences in terms of the efficacy of various filters (590 nm vs. 755 nm) could not be determined [65].

Bitter also observed an improvement of 10–90% after treatment with the VascuLight™ in rhytids and skin structure, irregular pigmentation, pore size, and telangiectasias. The best results were documented in cases of rhytids, large pores, and telangiectasias [61]. The majority of adverse effects in all three studies were transient erythema and, more rarely, blistering [59,61,65].

Negishi et al. first performed the technique of non-ablative skin rejuvenation via an IPL system (VascuLight) in patients with skin types IV–V. In their first study, they were able to achieve an improvement of 56–100% in terms of pigmentation, telangiectasias, and skin structure in 66–91% of their patients [62]. In their second study, a combined rating of over 60% improvement was determined in over 80% of patients [66]. Transient erythema and blistering were the most commonly reported adverse effects. Interestingly, there were no reports of scarring or changes in pigmentation in any of the cases, regardless of dark skin types [62,66].

Hernández-Pérez et al. reported moderate to very good improvement in terms of fine wrinkles, dilated pores, skin thickness, oily skin, and general appearance of the facial skin of five Hispanic women after five treatments with the VascuLight Plus [67].

CONCLUSION

High intensity pulsed flashlamp systems are a successful and a non-invasive means of treatment; they provide a viable alternative to laser systems and conventional therapeutic options when it comes to treating a series of indications. IPL technology has particularly proven its worth in the medical treatment of therapy-resistant port-wine stains and venous malformations. It has also permitted numerous therapeutic options in the field of esthetic medicine. The low rates of adverse effects combined with the method's proven efficacy are supposed to bring about high levels of patient satisfaction, especially in cosmetic indications such as hypertrichosis or telangiectasias. Because of the wide range of potential combinations of wavelengths, pulse durations, pulse frequency, and fluences, working with IPL equipment is a complex matter which requires a great amount of experience. Newer models are simpler to use, but this simplicity restricts the operator's ability to select the optimal individual treatment parameters and thus affects the indications for which the equipment can be used.

Given critical diagnostics and proper use, IPL technology is an alternative option to well-established laser treatment methods and has an indisputable role in dermatology and esthetic medicine.

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