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Original Research

Intense pulsed light source for treatment of small melanocytic nevi and solar lentigines

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OBJECTIVE: **The purpose of this clinical study was to evaluate the effectiveness of an intense pulsed light (IPL) irradiator system for the treatment of benign pigmented lesions.**
MATERIALS AND METHODS: **A total of 18 patients with lentigo solaris and eight patients with melanocytic nevi were treated once with an IPL system. After 2 months, the effect was evaluated on close-up photographs.**
RESULTS: **Pigment reduction was obtained in 96% of the patients, and the average clearance was found to be 74.2% and 66.3% for lentigo solaris and melanocytic nevi, respectively.**
CONCLUSION: **The IPL was found to be effective for removal of benign pigmented lesions.** *J Cutan Laser Ther* 2000; **2**: 177–181

Introduction

Both normal mode, Q-switched lasers and intense pulsed light (IPL) irradiators are currently used for treatment of pigmented lesions. These different devices vary considerably regarding wavelengths, energy levels and pulse durations. Both Sherwood et al[1] and Anderson et al[2] exposed pigskin to different wavelengths to find the optimum wavelength for treating pigmented lesions. Sherwood and colleagues tested 504 nm, 590 nm, 694 nm, 720 nm and 750 nm and found 504 nm to be optimal, whereas Anderson and colleagues, who tested 355 nm, 532 nm and 1064 nm, found 532 nm to produce optimal pigment clearance. These findings reflect that a compromise between a high absorption in melanin and a lesion-specific depth penetration depth is needed. In addition, other investigators show high efficacy in the clearance of pigmented lesions using wavelengths in this range.[3–7]

The biological effect of both IPLs and normal mode lasers is thermal damage of the pigment-containing cells, whereas the effect of Q-switched lasers is based on a photo-acoustical effect.[8,9] Pulse durations from as low as 10–50 ns in Q-switched laser systems and up to 200–300 ms have all been reported efficacious. Goldberg[10] reported that new long-pulsed pigment-specific lasers might prove to further enhance the clinical results in resistant pigmented lesions. In contrast to lasers, the pulse duration of IPLs can be varied over a very broad range of time. In general, treatment of superficially located pigmented lesions such as the epidermal lentigo solaris is highly successful,[7,11,12] and clearances of up to 60–70% have been reported. Pigmented lesions

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located much deeper, such as melanocytic nevi and the follicular, pigmented components of Becker's nevi, are more resistant to treatment.[13] The final cosmetic outcome of treatments with both lasers and IPLs is highly dependent on light source, the number of treatments and the intervals between these, as well as biological variables – for example type and depth of lesion, and anatomical location.[14]

In the present study, the effectiveness of a single treatment by an IPL of benign pigmented lesions was evaluated.

Patients and methods

Patients

The study included 26 patients with a mean age of 41.5 years (SD: 7.4 years). Three patients belonged to the Fitzpatrick's skin type 1, 20 to skin type 2 and three to skin type 3. All volunteers gave their written informed consent, and the study was approved by the Regional Ethics Committee.

Intense pulsed light irradiator

An IPL (Ellipse Flex; Danish Dermatologic Development (DDD), Hoersholm, Denmark) was used for all treatments. This device emits an undulating train of pulses created by a xenon arc flashlamp. The total pulse duration consisted of two identical light pulses, each 7 ms separated by an interval of 25 ms. The wavelength spectrum of the present IPL system was designed in accordance with results obtained by Sherwood et al[1] and Anderson et al,[2] and the average wavelength of the effect spectrum was placed at 540 nm (Figure 1). The emitted light is conditioned by two types of optical filters: a hot mirror filter and a water chamber in combination create the clinically useful light with a spectral range from 400 nm to 720 nm (Figure 1). The filtered light is guided to the skin surface by an 8-mm diameter light-conducting crystal. The optical coupling between the crystal and the skin surface is optimized by application of a thin layer of optical index-matching hydro-gel. Applying a firm mechanical pressure to the skin surface with the IPL system's optical light guide, causing most blood to be removed from the treatment area during treatment, further reduces non-selective absorption in superficial cutaneous blood vessels.

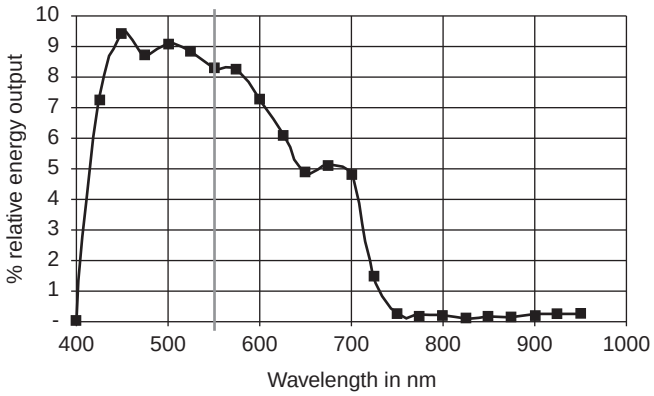

Figure 1
Spectral distribution of energy measured on the skin surface. Median wavelength of the total power spectrum is indicated (vertical line at 540 nm).

Experimental procedure

Only one lesion in each patient was used for the present investigation.

The fluences used for treatment of the different lesions were adjusted according to a pretreatment clinical evaluation of the degree of pigmentation of the lesion. High fluences were used for the treatment of lesions with the least pigmentation. The lowest fluences, which resulted in immediate separation of the pigmented layers from the underlying tissue, were used in order to cause a minimum of side effects.

Experiment I
A total of 18 patients with solar lentigines received a single IPL treatment with total fluences of 10–14 J/cm^2. Their average Fitzpatrick's skin type was 1.8 (SD: 0.65). Lesion sizes ranged from 3 mm to 10 mm.

Experiment II
Eight patients with a mean Fitzpatrick's skin type of 2 (SD: 0.53) with acquired, dark-brown, macular melanocytic nevi received one IPL treatment with total fluences of 14–20 J/cm^2. Lesion sizes ranged from 5 mm to 7 mm.

Treatment sites and numbers

The number of lesions in both experiments are shown in Table 1.

Treatment procedure

Clinical examination and close-up photography were performed before the treatment. The lesions were covered with a thin layer of transparent hydro-gel (Optical Coupling Gel; DDD. All treatments were

Number of lesions treated	Solar lentigines	Melanocytic naevi
Arms	13	6
Dorsal side of hands	3	0
Faces	2	1
Legs	0	1

Table 1
Site of the pigmented lesions treated.

performed with a significant mechanical pressure to avoid absorption in the upper dermal vessels. Chlorohexidine cream 1% was used three times a day in cases with epidermal detachment.

Adverse effects

Adverse effects of the treatments were predominantly separation of the epidermis followed by crusting or ulceration and erythema. Ulceration was evaluated by measuring the diameter of the lesion at day 1, day 12, day 30 and day 60 after the treatment. In addition, the degree of erythema was assessed by grading in four stages: 1 = none; 2 = slight (1–24%); 3 = moderate (25–49%); and 4 = severe (50–100%). In all cases, the treatments were felt as a brief pin-prick followed by a burning sensation for some seconds. The pain levels were comparable with those reported by patients undergoing Q-switched ruby laser treatments.

Statistics

For statistical evaluations, Wilcoxon's test was used. A significance level of 0.05 was accepted.

Results

Experiment I: solar lentigines

A clinical effect was observed in 17 of the 18 patients treated. The effect of the IPL treatment on solar lentigines is shown in Figure 2. After 1 month a clearance of 88.3% (SD: 15.1%) was obtained. After 2 months some lesions partly recurred, and the clearance was now reduced to 74.2% (SD: 29.8%). The difference between the evaluation at 1 month and 2 months after treatment was not statistically significant ($p > 0.1$). A typical example is shown in Figure 3.

Experiment II: melanocytic nevi

The effect of the IPL treatment on melanocytic nevi is shown in Figure 4. A clinical effect 2 months after the last

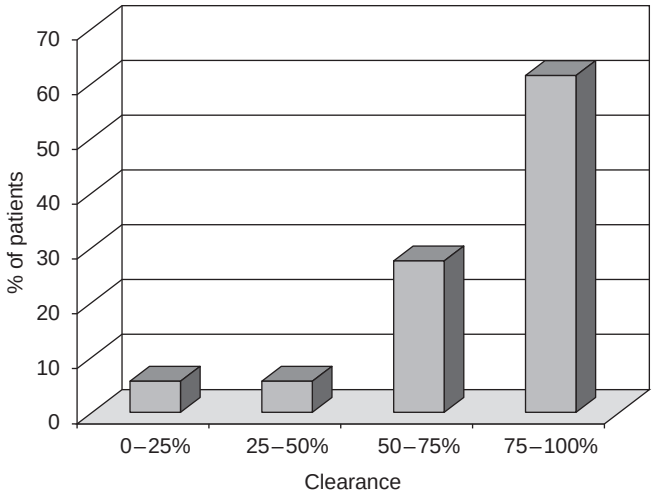

Figure 2
The percentage of lentigo solaris that were cleared after a single IPL treatment. The evaluation was performed after 2 months.

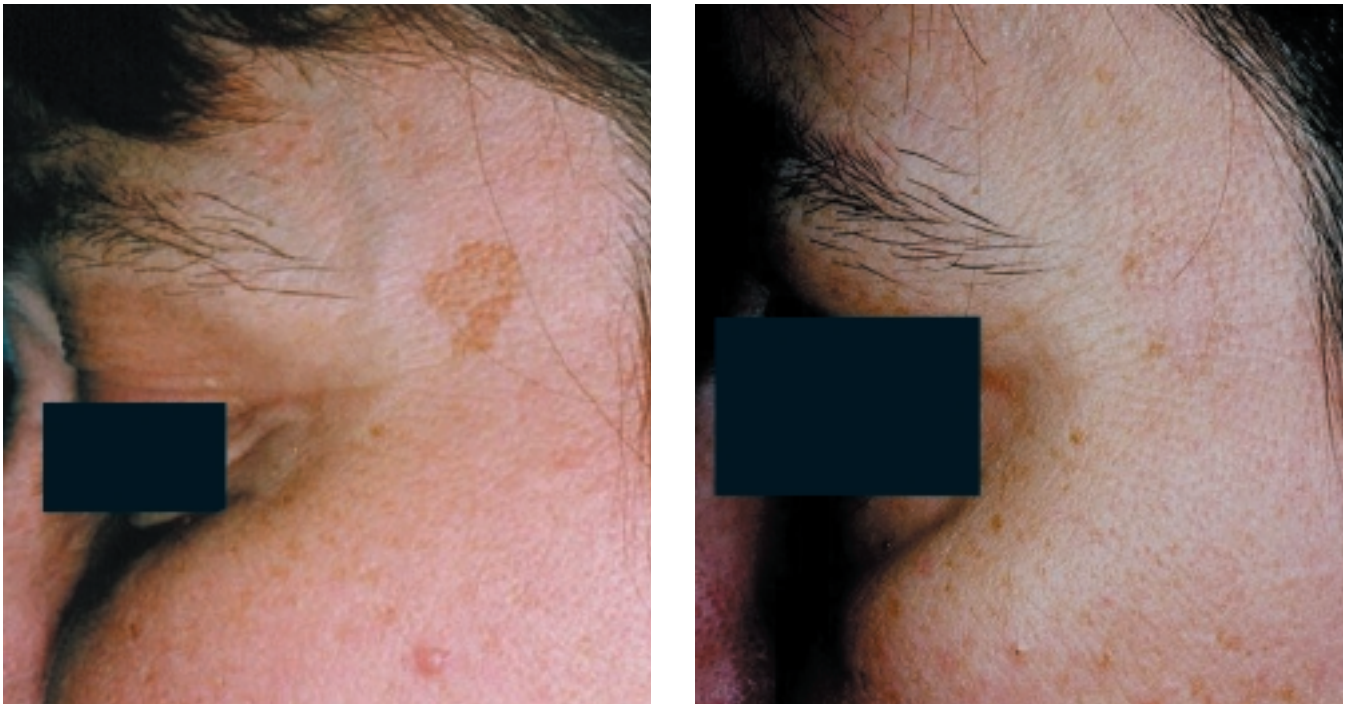

Figure 3
IPL treatment of lentigo solaris. (A) Before treatment; (B) after a single treatment: 14 J/cm^2. Typical result with clearance of 80% at 2-month follow-up.

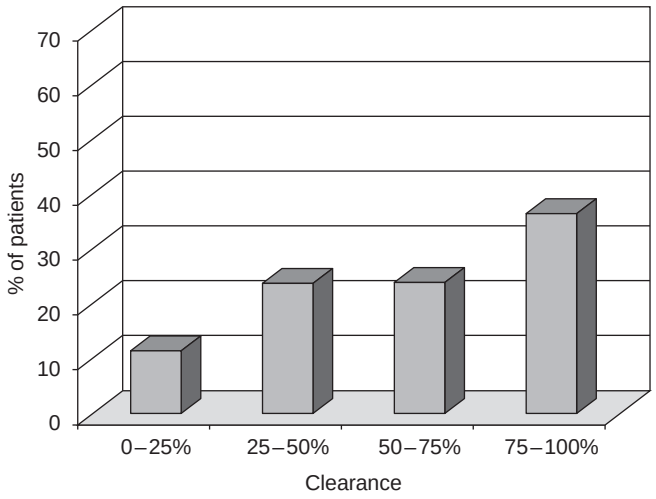

Figure 4
Percentage clearance of acquired melanocytic nevi after a single IPL treatment. Evaluation after 2 months.

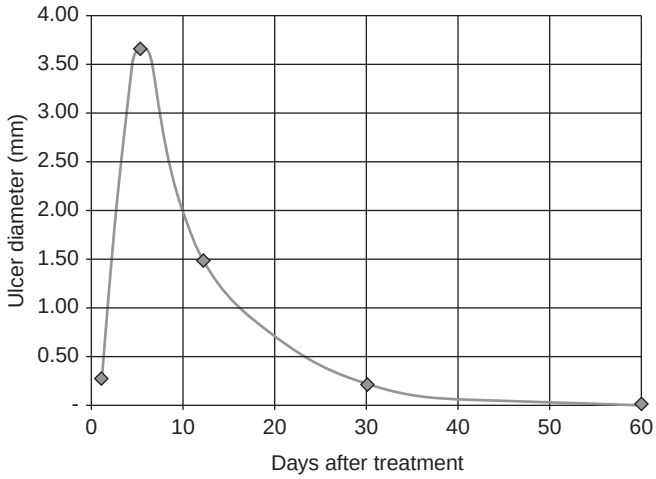

Figure 5
Average size of ulcer diameter during the follow-up period.

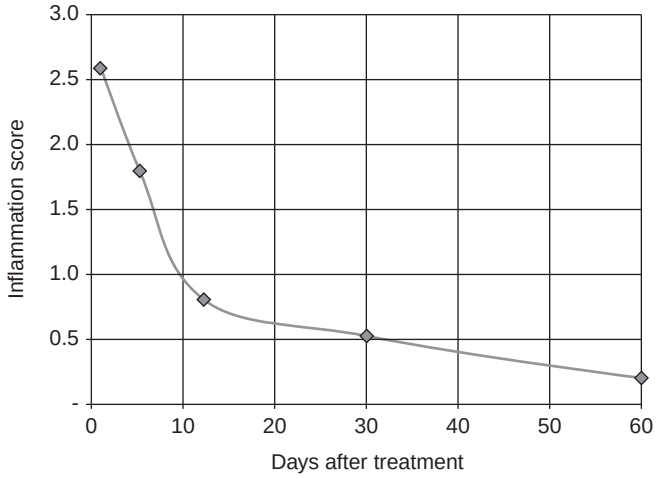

Figure 6
Average degree of erythema scores during the follow-up period.

treatment was obtained in all lesions, and the average clearance was 66.3% (SD: 31.3%).

Adverse effects

Superficial crusting was observed in all lesions treated. In 88.9%, crusting was followed by ulceration, and subsequently all lesions developed some degree of erythema. The diameter of the ulcerations increased during the first days after treatment, and the maximum average diameter was found on day 5. The average ulcer diameter was 3.7 mm (SD: 2.1 mm). On day 12, the average diameter of ulceration was half the maximum size and, except in one patient, all ulcerations were healed after 30 days (Figure 5).

For solar lentigines the intensity of erythema decreased during the postoperative period, as shown in Figure 6. The maximum erythema was observed the first day after treatment and the intensity was 2.56 (SD: 0.81) (scale: 0–4). After 30 days, the intensity of erythema had reduced to 0.54 (SD: 0.54). After 60 days, the intensity of erythema was still 0.22 (SD: 0.43). For melanocytic nevi, a more prolonged duration of erythema was observed. After 60 days the intensity of erythema was still 1.0 (SD: 1.07). No scars were observed after these treatments of pigmented lesions with the present IPL.

Discussion

Controversies exist regarding the treatment of pigmented lesions of the skin without histological verification of the diagnosis. Optical treatment excludes this possibility; it is, however, our opinion that certain pigmented lesions can be diagnosed accurately as being benign by a trained dermatologist.

In the present study, light fluency was adjusted for each patient according to the degree of pigmentation of the lesion in order to optimize treatment efficiency and to minimize side effects. The clearance rate was highest for solar lentigines; however, a single treatment was not always sufficient. In a study by Shimbashi et al,[14] pigmented lesions were treated once or twice with a Q-switched ruby laser and the response rate was 70%. Duke et al[15] showed that although 52% of patients with benign nevi had a clinical effect after one or two Q-switched or normal mode ruby laser treatments, no lesions had complete histological removal of all melanocytes. Tan et al[16] found that, depending on the type of pigmented lesion, between two and four treatments with a 504 nm dye laser were required to completely eradicate the lesions. Lightly pigmented lesions are even more difficult to treat due to weak absorption of the incident light. In a study of the 510 nm pulsed dye laser, Alster and Williams[5] found that an average of 8.4 treatments were needed to eliminate

café-au-lait birthmarks. In contrast, Taylor and Anderson[11] used a Q-switched ruby laser and produced effective treatment for lentigines and for café-au-lait macules but not for nevus spilus. Until now, only scarce information has been published on the use of IPLs for the treatment of pigmented lesions.[17] A series of four treatment sessions were reported to be sufficient to clear a nevus spilus. In the present study, the IPL provided clinical response in 96.2% of the patients treated when the evaluations were performed after 2 months. However, both the follow-up period and the number of lesions included in the present study may not be sufficient to fully evaluate the potentials of this treatment modality as well as the true incidence of recurrence. Therefore, the obtained results should be confirmed in larger studies.

Conclusions

We support previous findings that the IPL is both safe and efficacious for the treatment of benign pigmented lesions.

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