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VASCULAR LESIONS

(532 & 577 nm)

577-nm high-power optically pumped semiconductor laser is safe and effective in the treatment of inflammatory acne: a prospective, single-center, split-face comparative study

E. M. Mohamed, K. M. Tawfik, I. B. Elsayed, E. Bölke and P. A. Gerber. 2021 september 09.
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Abstract

Objective: This study aimed to appraise the efficacy of a 577-nm high-power optically pumped semiconductor laser (HOPSL) for the treatment of inflammatory acne.

Methods: The study included 50 patients with acne vulgaris (inflammatory type), 14 men, and 36 women; patient ages ranged from 16 to 35 years. The left side of the face was treated with a single pass of a 577-nm high-power optically pumped semiconductor laser (HOPSL) every 2 weeks for 3 sessions. The severity of acne examined prior to the first session and 4 weeks after the last session (Investigator's Global Assessment of acne severity, IGA; single lesion count).

Results: At baseline, no statistically significant difference in the severity of inflammatory acne lesions between both sides was observed. One month after the final session, a significant improvement (IGA reduction of > 50%) of the overall severity of acne was observed in 49 patients (98%) on the laser-treated side versus 41 (82%) the control side of the face (P < .05). Hence, we found a significant reduction in the mean percentage of inflammatory papules, pustules, and nodules on the laser-treated versus the control side (79.33 vs 56.92, 78.04 vs 43.33, 64.85 vs 21.93%, respectively) (P < 0.05). Side effects in the form of erythema and irritation during sessions were transient and tolerated by the patients.

Conclusion: The 577-nm high-power optically pumped semiconductor laser is effective and safe for the treatment of inflammatory lesions (papules, pustules, and nodules) in acne patients.

Keywords: 577-nm diode laser, Acne, Vascular laser

1 | INTRODUCTION

Acne vulgaris is one of the most common skin condi- tions. Acne can be classified into non-inflammatory type(comedones), or inflammatory type (papules, pustules, and nodules) [1]. Acne commonly affects adolescents and young adults, can cause scarring, and can result in low self-esteem and affect mental health [2].

The pathogenesis of acne is multi-factorial and includes an overproduction of sebum, follicular hyper-keratiniza- tion, a colonization with Cutibacterium acnes, and a con- secutive inflammation [3]. Available treatment options for acne include mainly topical and oral drugs. One of the problems

of the topical treatment is that it requires frequent application (compli- ance), while the use of oral medications may be associ- ated with more severe side effects [4]. It is particularly important to treat acne before scars begin to appear, as even the most up-to-date laser treatments cannot guar- antee their full resolution [5].

Several types of lasers have been used to treat acne vulgaris in the past years. Of these, vascular lasers are reported to improve inflammatory acne lesions safely and efficiently [6]. Lasers are proposed to decrease Cutibac- terium acnes and to reduce the pilosebaceous unit size and function [7]. Here, we aimed to assess the efficacy of a novel 577-nm high-power optically pumped semicon- ductor laser (HOPSL) in the treatment of inflammatory type acne.

2 | PATIENTS AND METHODS

We conducted a single-center, prospective, half-side con- trolled, split-face study approved by the Ethics Commit- tee of Al-Azhar university hospital.

Exclusion criteria included non-inflammatory type acne, pregnant or lactating women, active herpes simplex infections, keloids or hypertrophic scars, photosensitiv- ity, immuno-compromised patients, and patients who had received systemic or topical antibiotics in the last month or oral isotretinoin in the last 6 months.

A total of 50 patients (14 males and 36 females) with inflammatory acne, with a mean age of 21.62 years (range: 16–29 years) and a mean duration of acne of 3.5 years (range: 1–7 years) were included in the study. According to Fitzpatrick skin type, 14 patients (28%) were classified as type III, 32 patients (64%) were classified type IV and 4 patients (8%) were classified type V.

The left side of the face was treated with a single pass of a novel 577-nm high-power optically pumped semicon- ductor laser (HOPSL) (QuadroStarPRO, Asclepion Laser Technologies, Jena, Germany) for 3 sessions at 2-week intervals. Fluence was started with 17 J/cm2 in the first session and was increased by 2 J/cm2 in every added ses- sion; pulse duration ranged from 28 32 ms according to the skin photo-type; the laser was applied in scanner- mode with a coverage of 80%. Patients were advised to avoid sun exposure and use topical sun protection with SPF > 30. No added acne-specific treatments were per- formed during the study period.

Patients were evaluated at baseline and 4 weeks after the final laser-session by clinical examination and stand- ardized photography (Canon PowerShot A3400 IS 16MP digital camera). Acne severity was quantified according to the Investigator's Global Assessment of Acne Severity Scale (IGA) and by single lesions count (inflammatory papules, pustules, and nodules).

3 | STATISTICAL ANALYSIS

The statistical analysis was carried out using SPSS (Sta- tistical Package for Social Sciences), version 21 (SPSS Inc. Chicago, IL, USA). Qualitative variables were expressed

mean ± standard deviation (SD) and the differences were as frequency and percentage. Data were presented as evaluated by an independent sample t-test. A value of 0.05 or less was considered significant.

4 | RESULTS

At baseline no statistically significant difference in acne severity was noted between laser and non-laser-treated sides. At the end of the study, a significant improve- ment in acne severity (IGA reduction > 50%) was seen in 49 patients (98%) on laser-treated side versus 41 (82%) on the non-laser-treated side of the face ($P < 0.05$) (Fig. 1; Table 1). At the final visit, there was a significant reduction in the mean percentage of inflammatory acne lesions at the laser-treated side vs. the non-laser-treated side ($P < 0.05$). In detail, we found a relative reduction of inflammatory papules (79.33 vs 56.92%), pustules (78.04 vs 43.33%), and nodules (64.85 vs 21.93%) for the laser- treated side vs. the non-laser-treated side (Fig. 1; Table 2). Reported side effects for the laser-treated side were mild and included transient erythema and irritation during sessions. Side effects were well-tolerated by the patients.

5 | DISCUSSION

Acne vulgaris is common skin diseases, which varies in severity between patients and may affect the psychologi- cal state of affected patients [8]. Acne can be classified into inflammatory and the non-inflammatory type. There are several ways to treat acne, including topical formu- lations and oral medications, as well as energy-based treatments. The treatment of choice or combinations thereof depends on disease type and severity, its effect on patients' psychological status, and the presence of con- traindications to any line of treatment [9].

Laser- and intense pulsed light (IPL) systems have been have been proven as effective in the treatment of inflam- matory acne with favorable side effects [10, 11]. Vascular lasers, including pulsed dye lasers (PDL), are one of the most common type of lasers used in acne treatment [6, 12]. Alexiades-Armenakas reported that 19 patients with inflammatory acne vulgaris achieved excellent responses after 595-nm PDL therapy [13]. Further studies con- firmed significant effects for PDL therapy in acne patients [14], whereas another representative split-face study on 40 patients with facial acne treated with non-purpuric PDL did not show significant improvements [15].

Comparable to a 595-nm PDL, a novel 577-nm highpower optically pumped semiconductor laser (HOPSL) (QuadroStarPRO, Asclepion Laser Technologies, Jena, Germany) emits yellow light of a comparable wavelengths. HOPSL was shown to effectively treat various vascular and pigmented skin conditions [16–18]; yet, to date no study has assessed its efficacy in inflammatory acne. In the present study, a single pass of the 577-nm HOPSL was applied to one half of the face of patients suffering from inflammatory acne, achieving a significant improvement in the vast majority of cases (significant improvements in IGA as well as single lesion count). Side effects were mild and well-tolerated. In line with other vascular laser- and IPL-systems, the following mechanisms of action can

be postulated: the 577-nm diode laser reduces Cutibacterium acnes through absorption of light by bacterial porphyrins and consecutive generation of reactive oxygen (ROS). Moreover, the laser generates photothermal effects via heating of the blood vessels and sebaceous glands [6, 19]. Finally, vascular laser treatments have been shown to induce transforming growth factor beta (TGFbeta), suggesting additional anti-inflammatory effects [9]. In conclusion, our study shows that the 577-nm highpower optically pumped semiconductor laser (HOPSL) is safe and effective in the treatment of inflammatory acne vulgaris.

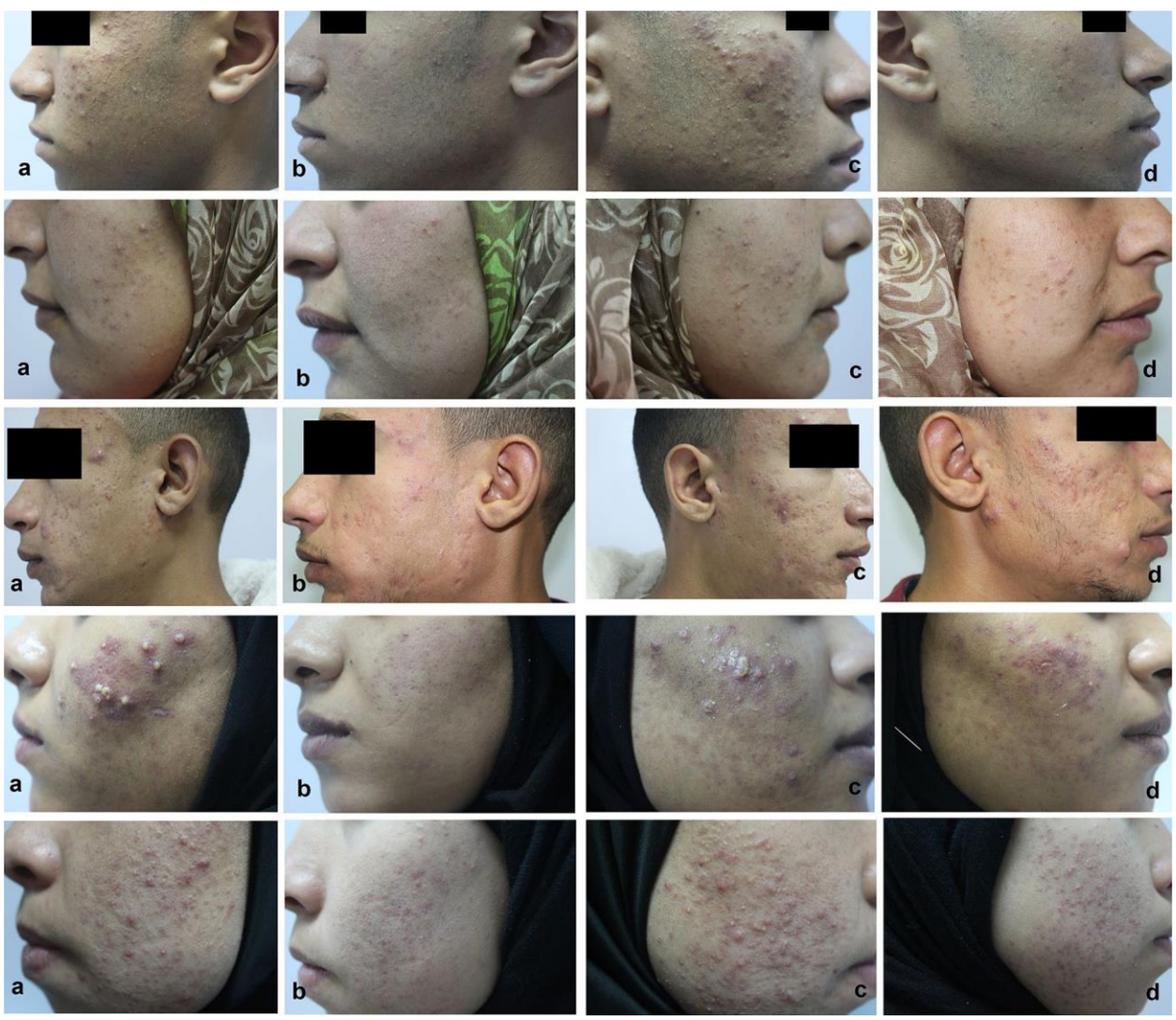

Fig. 1. 577-nm high-power optically pumped semiconductor laser (HOPSL) is effective in the treatment of inflammatory acne vulgaris: five representative cases, showing acne severity at baseline (**a**, **c**) and 4 weeks after treating the left side of the face with 3 sessions of 577-nm high-power optically pumped semiconductor laser (**b**) versus no treatment for the right side of the face (**d**). Clinical improvements were significantly better on the laser-treated side (**b** vs. **d**)

Table 1 Outcome of treatment (severity of acne, IGA)

	Laser-treated side *n* (%)	Non-laser-treated side *n* (%)	*p*-value
Clear (100%)	15 (30%)	8 (16%)	0.002*
Almost clear (75%–< 100%)	29 (58%)	11 (22%)	
Marked improvement (50–< 75%)	5 (10%)	22 (44%)	
Moderate improvement (25–< 50%)	0 (0%)	7 (14%)	
Slight improvement (1–< 25%)	0 (0%)	1 (2%)	
No change (0%)	1 (2%)	1 (2%)	

Chi-square test was used

Data expressed as *n* (%)

P. value < 0.05 is significant

Table 2 Mean percentage of improvement acne lesions after treatments

	Laser-treated side	Non-laser-treated side	*p*-value
Papule	79.33±27.94 (0–100)	56.92±27.20 (0–100)	0.001*
Pustule	78.04±47.47 (0–100)	43.33±47.49 (0–100)	0.001*
Nodule	64.85±41.48 (0–100)	21.93±38.88 (0–100)	0.001*

Independent T test was used

Data expressed as mean ± SD (range)

P. value < 0.05 is significant

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Evaluation of the efficacy of pro-yellow laser in the management of vascular skin disorders

Gulhan Aksoy Sarac, Meltem Onder. J Cosmet Dermatol. 2021 Apr 19. doi: 10.1111/jocd.14162.

Abstract

Background: Lasers have great importance in the management of vascular skin lesions.

Aim: To determine the efficacy of 577-nm pro-yellow laser in cure of certain vascular skin diseases.

Material and methods: Seventy-four patients who are diagnosed as vascular skin diseases were involved in this study. All participants were treated with 577-nm pro-yellow laser with 4-week intervals. The photographs that were taken before and at every following visit were used to evaluate improvement.

Results: A significant improvement occurred in port-wine stain, rosacea, facial telangiectasia, venous lake, scrotal angiokeratoma, and cherry angioma cases.

Conclusion: Vascular skin lesions can be treated with 577-nm pro-yellow laser with a minimal adverse effect and great success rate.

1 | INTRODUCTION

Vascular skin lesions, which are characterized by defect in blood vessels, occur due to the disorders of vascular development.[1] While this condition can occur in the whole body, 60% of them are located in the head and neck regions.[2] Among these vascular lesions, facial telangiectasia, erythematotelangiectatic rosacea, port-wine stains, venous lake, spider angioma, and cherry angiomas can be counted.

Laser is one of the most common options, which can be used in the management of vascular lesions. It targets intravascular oxyhemoglobin to destruct various vascular lesions. There are several types of lasers used in the treatment of vascular lesions, such as argon (488–514 nm), copper vapor (578 nm), pulsed dye (585–595 nm), and Nd:YAG laser (532–1064 nm).[3]

A 577-nm pro-yellow laser, which has been used to treat diabetic retinopathy for 20 years, has an ideal wavelength for treating vascular skin disorders.[4]

There are a limited number of studies in the literature evaluating the efficacy of pro-yellow laser on vascular skin lesions. Therefore, we aimed to determine the effectiveness of 577-nm pro-yellow laser on vascular skin lesions as port-wine stain, facial telangiectasia, and erythematotelangiectatic rosacea.

2 | MATERIALS AND METHODS

This study was administered retrospectively. A total of 74 patients who admitted to our dermatology clinic and treated with the pro-yellow laser were retrospectively evaluated. The diagnosis was made based on clinical examination and detailed histories. No biopsy was performed for the diagnosis. Informed consent forms were obtained from all participants, and the study was executed in accordance with the ethical standards as laid down in the 1964 Declaration of Helsinki and its later amendments or comparable ethical standards.

2.1 | Application of laser

Topical anesthesia with 5% lidocaine cream was applied in the area where laser planned 30 minutes before the treatment. After providing antisepsis, pro-yellow laser was applied. One to four sessions of pro-yellow laser were applied to all patients with 4-week intervals (Table 1). All of the patients were treated with 577-nm pro-yellow laser (QuadroStar PRO YELLOW Asclepion Laser Technologies, Germany) with a fluence of 18 J/cm^2 in the basic mode of the device. Cold application was performed after the sessions, and the patients were recommended to use sunscreen regularly.

	PWS (n = 6)	ETR (n = 13)	FT (n = 37)	VL (n = 6)	SA (n = 6)	CA (n = 4)	SAk (n = 2)
Number of sessions (Mean)	3,33	2,23	1,83	1,5	1,16	1	2

Abbreviations: CA, cherry angioma; ETR, erythematotelangiectatic rosacea; FT, facial telangiectasia; PWS, port-wine stain; SA, spider angioma; Sak, scrotal angiokeratoma; VL, venous lake.

TABLE1 Number of sessions according to diagnoses

2.2 | Patient's evaluation

The assessment of the treatment was based on clinical examination and digital photographs at baseline and four weeks after the last session. Improvement was rated as excellent (75%–100%), very good (50%–74%), good (25%–49%), and poor (<25%). Also, the occurrence of any adverse effects during or after the session was noted.

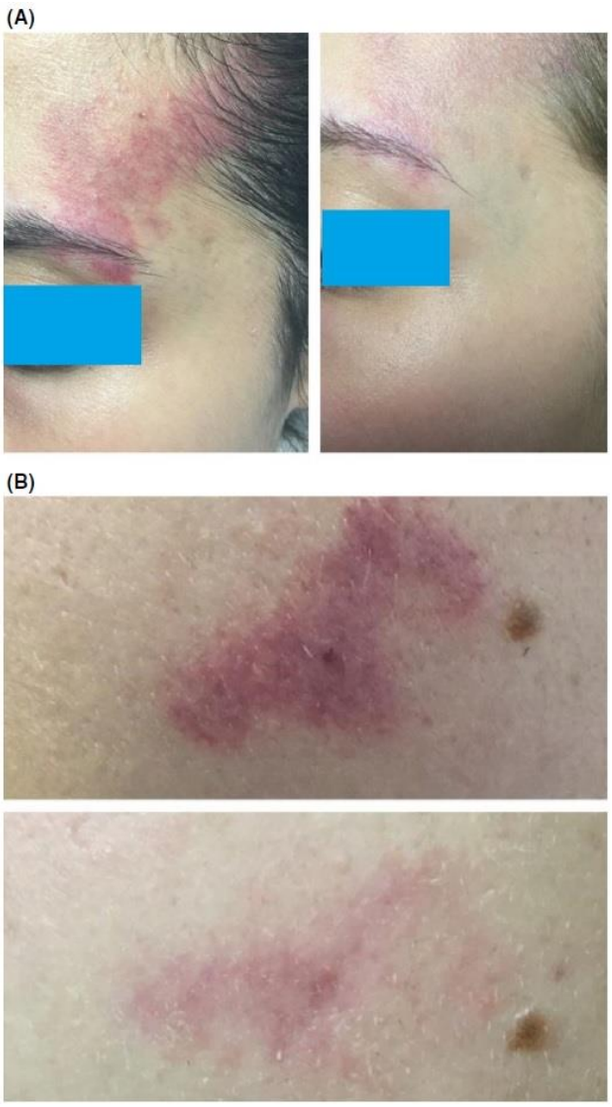

FIGURE1 Patient with port-wine stain and recovery after four sessions

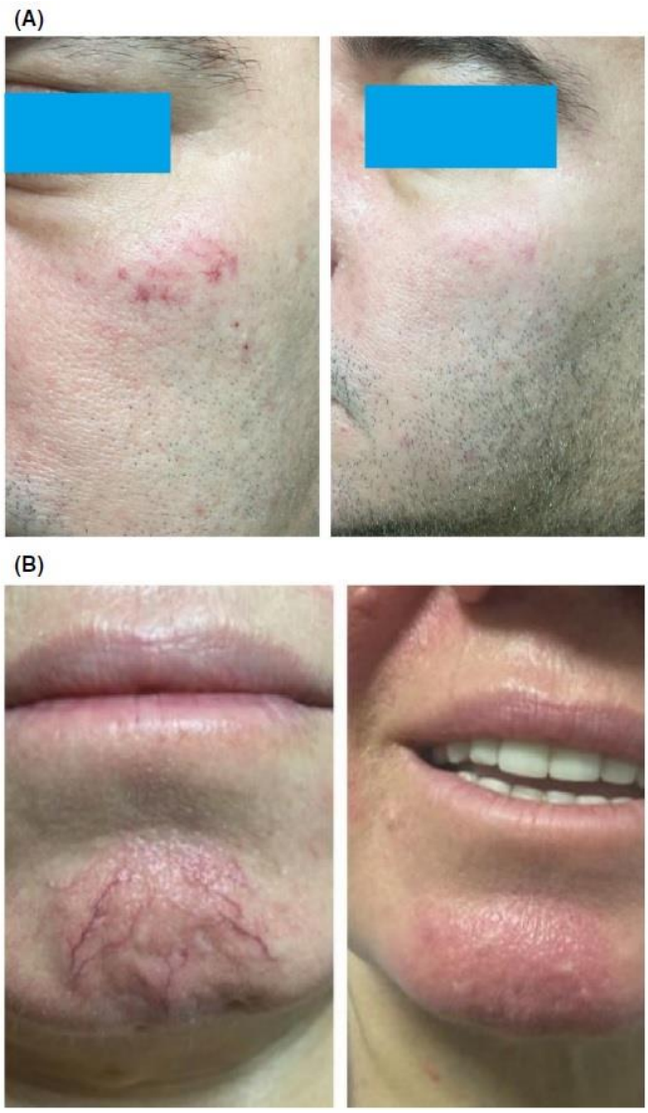

FIGURE2 Patient with facial telangiectasia and recovery after three sessions

2.3 | Statistical evaluation

The SPSS for Windows version 25.0 software was used for the statistical evaluation of the study data. Mean (X) ± standard deviation (SD) was utilized for the data regarding quantitative variables and number (n) and percentage (%) for qualitative data. Statistical evaluation of the data was conducted with the Pearson chi-square test and Fisher's exact chi-square test. p value <0.05 was accepted as statistically significant.

3 | RESULTS

A total of 74 patients were included in the study. 53 patients (71.6%) were female, and 21 patients (28.4%) were male with the mean age of 40.97 ± 7.77 (ranged between 28 and 63 years). 34 of the patients had Fitzpatrick type 2 (45.9%), and 40 patients had Fitzpatrick type 3 (54,1%) skin type.
The diagnosis was facial telangiectasia in 37 patients, erythematotelangiectatic rosacea in 13, port-wine stain in 6, spider angioma in 6, venous lake in 6, cherry angioma in 4, and scrotal angiokeratoma in 2 patients. There were excellent improvement in 1 case in patients with port-wine stain (16.7%) and very good improvement in 6 (83.3%) cases (Figure 1). In patients with facial telangiectasia, there were excellent improvement in 26 (70.3%) cases and very good improvement in 11 (29.7%) cases (Figure 2). In rosacea patients, there were excellent improvement in 6 (46.2%) cases, very good improvement in 6 (46,2%) cases, and good improvement in 1 (7.6%) case (Figure 3). In patients with venous lake, there were excellent improvement in 3 (50%) cases and very good improvement in 3 (50%) cases (Figure 4). In patients with cherry angioma, spider angioma, and scrotal angiokeratoma, excellent improvement was seen in all cases (Figures 5,6). Transient erythema after the session disappeared within 24–48 h was the only complication recorded. No significant relationship was seen between the improvement of lesions after the treatment and patient's ages, sex, and skin phototypes ($p>0.05$).

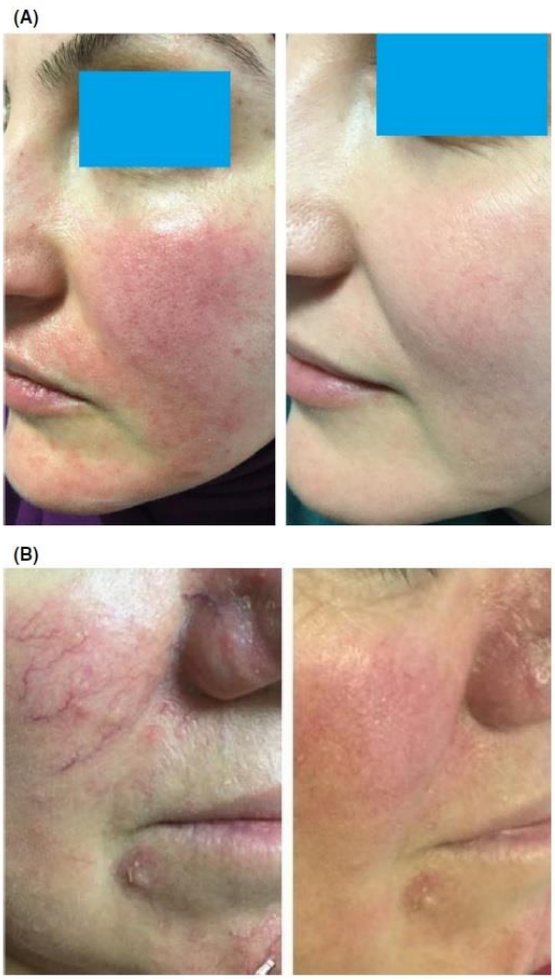

FIGURE3 Patient with rosacea and recovery after three sessions

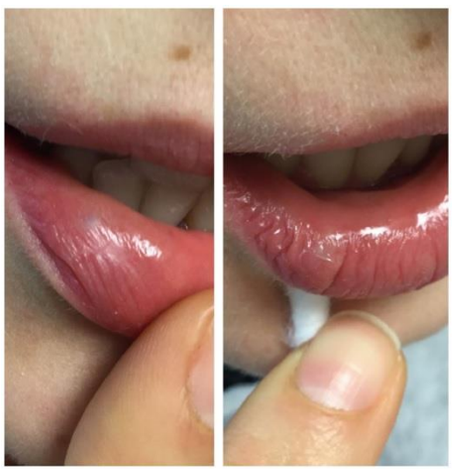

FIGURE4 Patient with venous lake and recovery after one session (hearing the “plop” sound during the procedure is the correct sign)

FIGURE5 Patient with spider angioma and recovery after one session

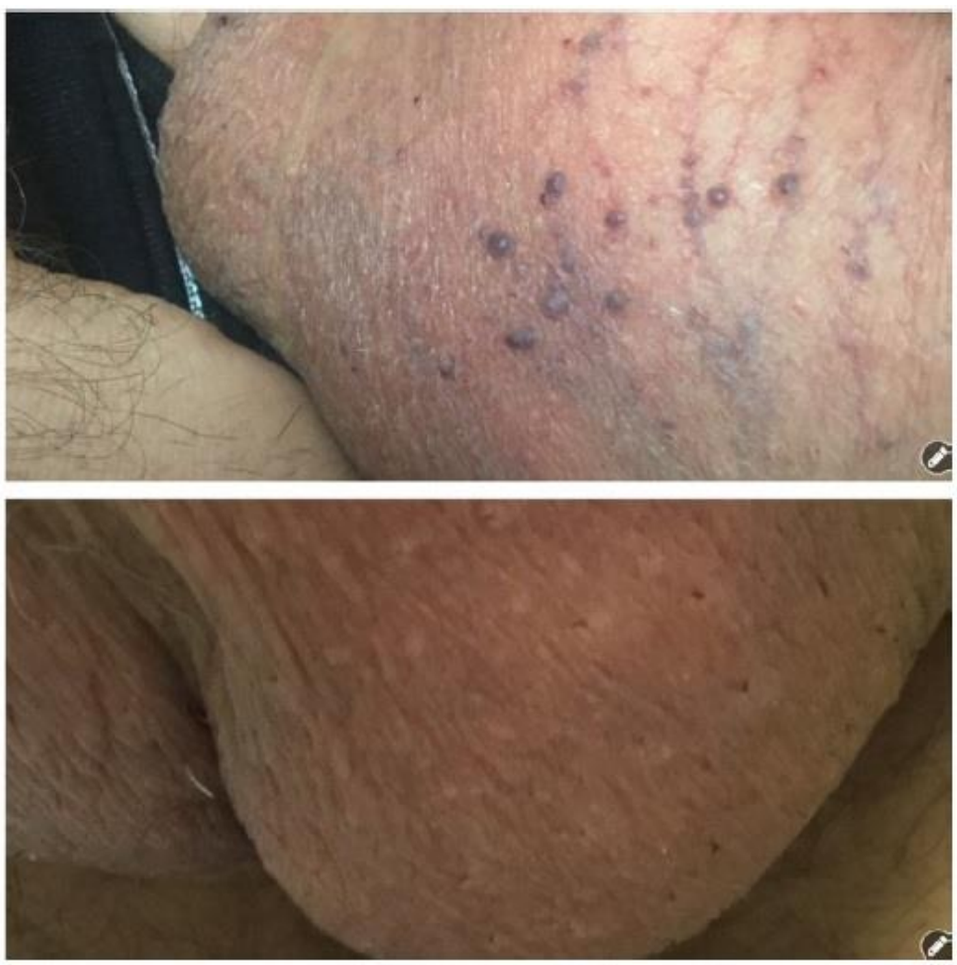

FIGURE6 Patient with scrotal angiokeratoma and recovery after two sessions

4 | DISCUSSION

Pro-yellow laser is 577-nm yellow light laser of which wavelength is ideal for treating vascular lesions. Pro-yellow laser has been used to treat superficial vascular lesions, telangiectasias, couperose skin, spider angiomas, port-wine stains, spider veins, warts, sebaceous gland hyperplasia, lentigines, and pigmented lesions. The copper bromide laser is a laser that contains two wavelengths as yellow and green light. Its wavelength is closest to the pro-yellow laser. This type of laser carries risk of postinflammatory hyperpigmentation due to containing two wavelengths as yellow and green, whereas the pure yellow light in pro-yellow laser allows it to use in the management of vascular lesions in individuals with dark skin.[5,6]

Telangiectasia is a vascular skin lesion, which can occur in various shapes and sizes. There are many etiological factors that cause telangiectasia such as topical corticosteroids, rosacea, sun exposure, and connective tissue diseases.[7] Because of the physical and psychological effects on people, the treatment of this condition has great importance.[8] The main chromophore is hemoglobin in erythema and telangiectasia. There are several laser types such as pulsed dye lasers, Argon laser, and Krypton lasers.[9] But many side effects such as hypopigmentation, pitted-depressed scars, postinflammatory hyperpigmentation, bullae, and crusts can be seen after the use of these lasers.[10] On the contrary, pro-yellow laser presents a minimal risk for hyperpigmentation and scar formation.[6] This procedure was used by Kapicioglu et al for treating facial erythema, erythematotelangiectatic rosacea, port-wine

stains, and facial telangiectasia, and in these studies, they suggested that it is effective and reliable.[6,11] Also, Mohamed et al. used this laser to treat facial vascular lesions and suggested that only a few sessions are sufficient for effective results in facial erythema, whereas port-wine stains require longer sessions. They considered this laser safe in the treatment of vascular lesions successfully.[12] In our study, we used this laser for the treatment of several vascular lesions. We found high success rates with a small number of sessions in the treatment of facial telangiectasia, erythematotelangiectatic rosacea, and port-wine stains in accordance with the literature. We also had great success rates when treating other vascular skin lesions included in venous lake, cherry angioma, and scrotal angiokeratoma with no side effects such as hyperpigmentation, bullae, and scar formation that are seen after the application of other laser systems. This is the first report in the literature on the use of the pro-yellow laser for the treatment of venous lake, cherry angioma, and scrotal angiokeratoma. Mild erythema that faded away in 12–24 h after the session was the only side effect seen after pro-yellow laser treatment.

In the treatment of vascular skin lesions, several types of laser have been used. Some of them require additional materials, for example, dye in pulsed dye laser or gel and cooling equipment in IPL laser. But pro-yellow laser does not require additional equipment as an advantage.[6]

The limitations of this study are as follows: Patients younger than 5 years were not included in the pediatric age group, and also, severe forms of vascular problems are not taken into account.

In conclusion, we suggest that pro-yellow laser is a good alternative in the treatment of vascular skin lesions. If you see mild or moderate skin vascular concerns and are looking for a quick solution for treatment, pro-yellow laser is a good choice with short downtime. Our findings are similar to the literature. We have just wanted to emphasize although there are many types of laser systems, pro-yellow laser provides efficient results without side effects such as edema, petechia, and purpura. Patients' satisfaction rate is high. The pro-yellow device is small, compact, and user-friendly, and has integrated cooling system, these features make it practical for daily use in dermatology clinics.

CONFLICT OF INTEREST

No conflict of interest.

Ethical approval was waived by the local Ethics Committee of University in view of the retrospective nature of the study and all the procedures being performed were part of the routine care.

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An evaluation of the efficacy of a single-session 577 nm pro-yellow laser treatment in patientswith postacne erythema and scarring

Gulbahar Sarac, Yelda Kapicioglu, Huly Cenk. Dermatol Ther. 2021 Jan;34(1):e14611. doi: 10.1111/dth.14611. Epub 2020 Dec 10.

ABSTRACT

Erythema and scarring are among the most common complications of severe inflammatory acne. In this study, we aimed to share our experience with pro-yellow laser and document the efficacy and safety of this treatment in postacne erythema and scarring. The study included 40 patients, 24 (60%) females, and 16 (40%) males with a mean age of 29.5 ± 8.16 (min. 18 years, max. 57 years). The pro-yellow laser was applied to all patients as a single session with irradiation of 22 J/cm2. Improvement in postacne erythema and scars were evaluated after the treatment. The study included 40 patients, 24 patients (60%) were females and 16 patients (40%) were males with the mean age of 29.5 ± 8.16 (ranged between 18 and 57 years old). A total of 21 patients (52.5%) had good improvement (51%-75% regression), 10 patients (25%) had excellent improvement (76%-100% regression), and a moderate improvement (26%-50%) was detected in 9 patients (22.5%). Also, there were mild improvement (1%-25%) in 20 patients (76.9%) and a moderate improvement (26%-50%) in 6 patients (23.1%). We found that pro-yellow laser is highly effective in the treatment of postacne erythema, while its effectiveness was mild to moderate in atrophic acne scars. Also, it has been observed that the pro-yellow laser system can be used safely immediately after cessation of systemic isotretinoin treatment.

Keywords: postacne erythema, postacne erythema treatment, postacne scarring, pro-yellow laser, vascular laser

1 Introduction

Acne vulgaris is one of the most common dermatological disorders seen in adolescents. Postacne scars and erythema may be seen in up to 80% of patients with severe acne an even may be permanent in fair-skinned population.1 The treatment of postacne erythema and scars is as important as treating acne lesions. Several topical agents including 0.025% retinoic acid, 12% glycolic acid, 0.2% brimonidine tartrate, 5% tranexamic acid solution and vitamin C preparations have been used in the treatment.2 Also, vascular lasers such as 595 nm pulsed dye laser, Q-switched Nd: YAG laser, 1550 nm fractional Erbium-glass laser have been used in the treatment of erythema, and ablative or nonablative laser systems (in fractional or nonfractional modes) have been used in the treatment of acne scars.3 A 577 nm pro-yellow laser has been used in the treatment of diabetic retinopathy for about 20 years, and it has been used in the dermatological field approximately for the last 4 years.2 Pro-yellow laser irradiates only yellow light wavelength targeting oxyhemoglobin and thereby, it has an ideal wavelength for vascular lesions. It leads to fading of vascular lesions and reduction in erythema through thermal damage.4,5 In this study, the patients with postacne erythema and scars were treated with pro-yellow laser and the results were evaluated. To the best of our knowledge, there are not any studies in the literature showing the efficacy of pro-yellow laser in the treatment

of postacne erythema and scars. We think that our study results will be useful for the clinicians when managing these complications.

2 Materials and Methods

2.1 Patient Selection

The study included 40 patients who applied to our dermatology clinic and were diagnosed with postacne erythema, between January 2017 and January 2019. The diagnosis was made based on a detailed clinical history, and examination. Patients with a recent history of systemic isotretinoin treatment were also included in the study rather than waiting for a 6-month washout period. Those with connective tissue disease were not included in the study. Biopsy was not taken from any patient for diagnostic purposes. Informed consent forms to participate and publish were obtained from all the patients and the study was performed in accordance with the ethical standards as laid down in the 1964 Declaration of Helsinki and its later amendments or comparable ethical standards.

2.2 Laser Therapy

Topical anesthetic cream (2.5% lidocaine hydrochloride and 2.5% prilocaine [both wt/vol] [EMLA]; Astra Zeneca, Sodertalje, Sweden) was applied to the lesions 30 minutes prior to the treatment. Antisepsis was provided with octenidine dihydrochloride solution after cooling the operation field with an ice battery. All the patients were treated with 577 nm pro-yellow laser (QuadroStar PRO YELLOW Asclepion Laser Technologies, Germany) as a single session with a fluence of 22 J/cm^2 in the basic mode of the device. After the treatment, cold application was repeated with the ice battery, and the patients were recommended to use sunscreens on a regular basis.

2.3 Evaluation of the Patients

The patients were photographed before and 4 weeks after the treatment by using digital camera and evaluated by two different dermatologists. A 4-item score was used to evaluate the improvement in erythema and scarring, as follows; 1 point: 1% to 25% mild improvement, 2 points: 26% to 50% moderate improvement, 3 points: 51% to 75% good improvement, 4 points: 76% to 100% excellent improvement in erythema and scarring, respectively. When there were discrepancies between the scorings of the dermatologists, a mean value was calculated and used for the analyses.

2.4 Statistical Analysis

All analyses were performed by using IBM SPSS Statistics for Windows version 22.0 (New York). Qualitative data were expressed as numbers and percentages. Pearson chi-square analysis, Fisher's chisquare analysis, Monte Carlo corrected Pearson chi-square analysis were used for comparisons. In all analyses, the two-sided significance level was accepted as 0.05.

3 Results

The study included 40 patients, 24 patients (60%) were females and 16 patients (40%) were males with the mean age of 29.5 ± 8.16 (ranged between 18 and 57 years old). A total of 12 patients had Fitzpatrick type-2 (30%), 22 patients had Fitzpatrick type-3 (55%), and 6 patients had Fitzpatrick type-4 (15%) skin type. Half of the patients had a history of treatment with systemic isotretinoin. Pro-yellow laser treatment has been started immediately after stopping the systemic isotretinoin treatment. There were 15 female patients (62.5%) and 5 male patients (31.3%) using systemic isotretinoin treatment with no statistical difference between genders (P = .053). Postacne erythema was accompanied by scarring in 19 female patients (79.2%) and only in 7 of the male patients (43.8%). In 14 of the patients, postacne erythema was not accompanied by scarring. There was a statistically significant difference by gender (P = .021) in terms of concomitant erythema and scarring. The distribution of postacne erythema and scarring according to genders has been shown in Table 1.

TABLE 1 The distribution of co-occurrence of postacne erythema and scarring according to genders

Gender		Scarring (+)	Scarring (–)	Total
Female	Number	19	5	24
	% within gender	79.2%	20.8%	100.0%
Male	Number	7	9	16
	% within gender	43.8%	56.3%	100.0%
Total	Number	26	14	40
	% within gender	65.0%	35.0%	100.0%

In the evaluation of the improvement rates of erythema after a single-session laser treatment, we found that 21 patients (52.5%) had good improvement and 10 patients (25%) had an excellent improvement. A patient with a good improvement in postacne erythema has been shown in Figure 1 and one patient with an excellent improvement is shown in Figure 2. In nine of the patients (22.5%) a moderate improvement was observed. There was no statistically significant difference between the genders in terms of the improvement rates in postacne erythema (P: .52). The rates of improvement in post-laser erythema according to genders have been shown in Table 2. In the evaluation of the rates of improvement in acne scars, we found that 20 patients (76.9%) had a mild improvement, while 6 patients (23.1%) had moderate improvement. There was no statistical difference between the genders in terms of the rates of scar improvement (P: .021). The rates of improvement of scarring according to genders have been given in Table 3.

4 Discussion

Acne is one of the most common dermatological diseases that can be seen in all age groups, while it is seen up to 80% in the adolescent population.6 Severe inflammatory acne lesions may result in postacne erythema, hyperpigmentation or scarring. Most common types of atrophic acne scars include rolling, ice-pick and boxcar types.7 Although not life-threatening, postacne erythema and

scars have negative psychosocial impacts on the quality of life by causing decreased self-confidence and some anxiety disorders. Management of postacne erythema and scarring remains as a challenge and there is still no clear consensus.2 However, these complications usually persist when not treated. Since different laser systems have been used in treating in postacne erythema and scars, it is important to decide which lesions to treat first. While ablative or nonablative fractional lasers are used in scar treatment, vascular lasers are preferred mostly in erythema treatment8 thereby, the laser systems effecting both scarring and erythema are more favorable.

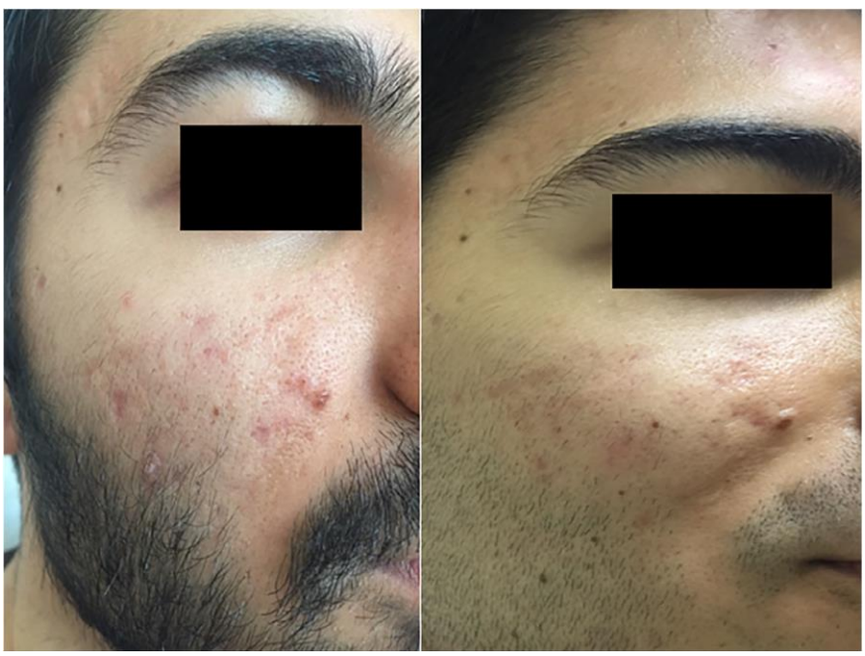

FIGURE 1 An improvement between 51% and 75% in postacne erythema was observed in the patient, whereas the improvement in the scars was between 26% and 50%

Pro-yellow laser has been used in the dermatological field for about 4 years, especially in the treatment of vascular lesions. In facial erythema, the target chromophore is hemoglobin. Hemoglobin has two absorption peaks in visible light, 542 and 577 nm. Pro-yellow laser, with its 577 nm wavelength, targets oxyhemoglobin and has been used effectively in the treatment of fascial erythema, telangiectasia and port-wine stain.4,5,9 Various laser systems (Argon laser, Krypton lasers, Potassium-titanyl-phosphate [KTP] lasers, pulsed dye laser, etc.) have been used in the treatment of fascial erythema and have also been reported to be effective.10 However, these systems have some serious major side effects like hypopigmentation and scars with Argon lasers,11 also, blisters, crusting, periorbital erythema and hyperpigmentation with Krypton lasers.4 Another handicap in the laser treatment is the necessity for waiting 6-month washout period after systemic isotretinoin treatment. Especially, application of ablative lasers immediately after systemic isotretinoin treatment may cause worse results. On the contrary, pro-yellow laser can be applied immediately after cessation of systemic isotretinoin treatment, which is an important advantage. Another technology used effectively in the treatment of postacne erythema is the Intense Pulsed Light therapy systems. However, it may cause serious side effects including hyperpigmentation, hypopigmentation, and scar formation, when especially applied in dark skin types.12 We did not observe any serious side effects

in any of the 40 patients included in the study. The most common side effect with pro-yellow laser was erythema, which lasted for approximately 30 minutes after the treatment. On the other hand, erythema which could last 1 week after the Pulse dye laser therapy, may be severe enough to cause a longer downtime. Hyperpigmentation has been reported as a major side effect in dark-skinned individuals. In addition, its efficacy on acne scars has not been demonstrated.13 Ablative and nonablative fractional laser systems used in acne scars may increase erythema rather than improving it.14

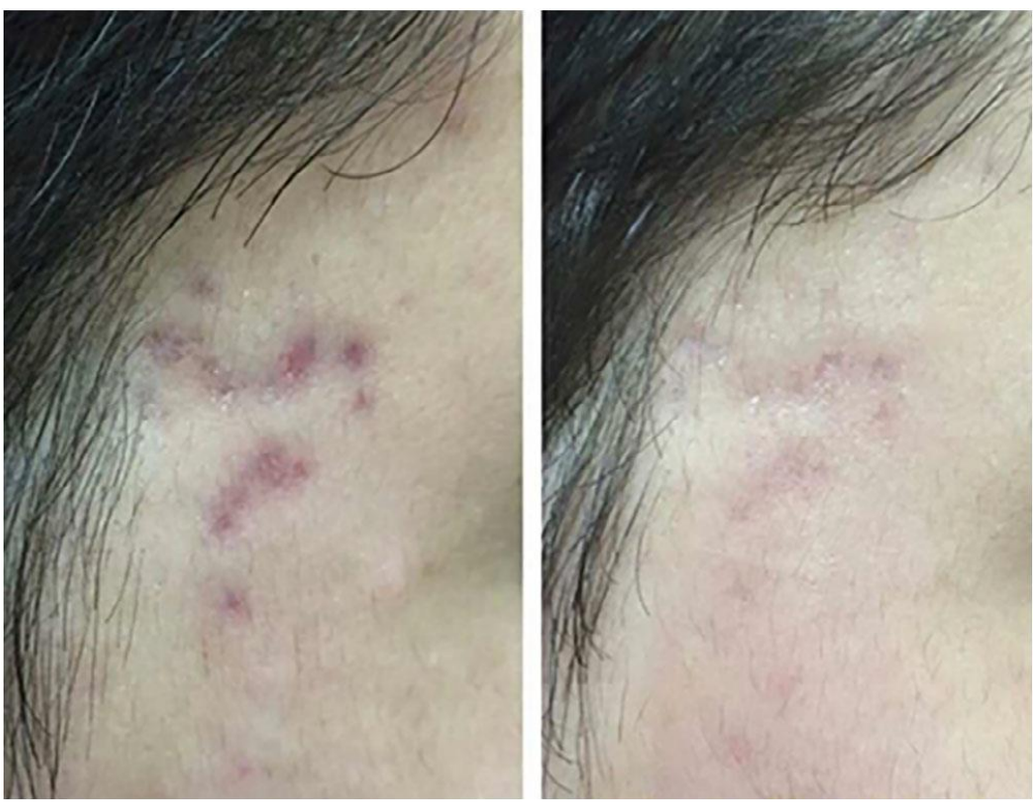

FIGURE 2 At the end of the first session, an improvement between 76% and 100% was observed in postacne erythema, while the improvement of acne scar was between 26% and 50%

There are few lasers that can improve both postacne erythema and acne scarring. In a study, Picosecond Alexandrite laser was found to be effective on both complications. However, repetitive sessions were required to obtain an effective response. Pro-yellow laser has achieved effective results even in a one single session, especially in postacne erythema.1 We found only one article in the literature about the effectiveness of 577 nm laser in postacne erythema. In this study conducted by Wanitphakdeedecha et al, three sessions of laser treatment were applied with 1-month intervals and it was reported that postacne erythema improved in 75% of the patients after the third session with an energy of 12 to 15 J/cm^2.2 On the other hand, we applied a fluence of 22 J/cm2 in a single session. Despite the high doses, we did not encounter any side effects in any of our patients. Wanitphakdeedecha et al had evaluated only postacne erythema, however, in our study, the improvement of the scars were also evaluated as well as postacne erythema.

TABLE 2 The rates of improvement in post-laser erythema according to genders

Gender		Moderate improvement (26%-50%)	Good improvement (51%-75%)	Excellent improvement (76%-100%)	Total
Female	Number	4	13	7	24
	% within gender	16.7%	54.2%	29.2%	100.0%
Male	Number	5	8	3	16
	% within gender	31.3%	50.0%	18.8%	100.0%
Total	Number	9	21	10	40
	% within gender	22.5%	52.5%	25.0%	100.0%

Cost-effectivity and ergonomic design of the laser devices are also important features. Pulsed dye lasers require a solution with an organic dye to create the laser effect, and this special dye brings an extra cost. Similarly, Nd: YAG lasers have a cooling system and this system may increase the expenditures and contribute to a poorer ergonomic design.4 On the other hand, pro-yellow laser seems to be superior to other vascular lasers in terms of cost-effectivity, erconomics and providing a minimal downtime as well as its safety even in the patients with a recent history of systemic isotretinoin treatment. Another advantage of pro-yellow laser is that it does not require a cooling equipment and does not require additional consumables for treatment.4

TABLE 3 The rates of regression of scars according to genders

Gender	Scarring (+)	Regression of scars		Total
Female	Number	13	6	19
	% within gender	68.4%	31.6%	100.0%
Male	Number	7	0	7
	% within gender	100.0%	0.0%	100.0%
Total	Number	20	6	26
	% within gender	76.9%	23.1%	100.0%

5 Conclusion

Pro-yellow laser, which is a vascular laser system, was applied in a single session in the treatment of postacne erythema, we observed well to excellent improvement in the patients, after the treatment. After it was used to treat postacne erythema, it was noticed that it also provided mild to moderate improvement in atrophic acne scars in patients. Despite the high treatment doses, no side effects were detected in patients. Another advantage of this laser is that it can be used immediately after stopping systemic isotretinoin therapy.

Conflict of interest: The authors declare no potential conflict of interest.

Author Contributions: All authors contributed to the study conception and design. Material preparation, data collection and analysis were performed by G.S. and Y.K. and H.C. The first draft of the manuscript was written by G.S. and all authors commented on previous versions of the manuscript. All authors read and approved the final manuscript.

Ethics statement: Ethical approval was waived by the local Ethics Committee of University in view of the retrospective nature of the study and all the procedures being performed were part of the routine care.

Data availability statement: The author elects to not share data.

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The efficacy and safety of a 577-nm high-power optically pumped semiconductor laser in the treatment of postacne erythema

Rungisma Wanitphakdeedecha et al. Journal of Cosmetic Dermatology 19:1642-1647.
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ABSTRACT

Background: Postacne erythema (PAE) is a common sequela of inflammatory acne vulgaris, treatment of which has been challenging due to limited options available and the variability of results for each modality. Recently, a 577-nm high-power optically pumped semiconductor laser (HOPSL) initially developed for vascular lesions has shown promising results for the treatment of PAE.

Aims: To evaluate the efficacy and safety of 577-nm HOPSL in the treatment of postacne erythema.

Methods: This was a split-face, randomized controlled trial pilot study. Twenty-one patients with PAE on both sides of their face were enrolled. Each subject's face sides were randomly assigned to either receive 577-nm HOPSL treatment (QuadroStar PRO™, Asclepion Laser Technologies) using the scanner handpiece, 1mm spot size, 80% coverage, 12-15 J/cm2, 30 ms, 2 passes for 3 sessions at 1-month intervals, or no treatment at all. Outcome measures such as overall improvement, the Erythema Index (EI), and Melanin Index (MI) from 3 different areas on both treatment and control sides were assessed at baseline, and 1-month follow-up after each treatment session. Side effects including pain, erythema, swelling, and crusting were also recorded.

Results: Upon completion of the treatment period, the mean EI was significantly decreased in both treated and nontreated sides of the face ($P < .001$ and $P = .001$, respectively). The laser-treated sides already demonstrated significant reduction in the mean EI compared with nontreated sides at 1 month after the 2nd treatment ($P = .007$). The mean MI of both sides, however, did not show any statistically significant differences from baseline, and likewise when comparing between sides. Patients reported more improvement on laser-treated sides compared with nontreated sides. Reported side effects were limited to mild discomfort during treatment and transient facial erythema lasting approximately 30 minutes.

Conclusion: Patients who received treatment with the 577-nm HOPSL had better outcomes with minimal side effects at 1 month after 2 treatments as compared to those who did not receive any treatment. Therefore, the 577-nm HOPSL may be considered as an effective adjuvant treatment for PAE and early erythematous atrophic scars.

Keywords: 577-nm high-power optically pumped semiconductor laser (HOPSL), Postacne erythema, Vascular-specific laser

1 Introduction

Acne remains to be one of the most frequent skin disorders in the adolescent and adult populations with a primary feature of comedone formation, later on developing into inflammatory papules, pustules, and nodules.1 Postacne erythema (PAE) otherwise known as postinflammatory erythema is a common sequela of inflammatory acne resulting in persistent telangiectatic and erythematous macules.2 Some PAE lesions can spontaneously resolve over time, but persistent lesions are quite common. Various topical treatments have been previously studied, but the efficacy and safety of these modalities have not yet been supported by large-scale or long-term trials. Some of these topical medications include a regimen of 0.025% retinoic acid combined with 12% glycolic acid, 0.2% brimonidine tartrate ophthalmic solution, 5% tranexamic acid solution, and vitamin C preparations.3-7 Treatment of PAE with lasers and energy-based modalities has likewise been challenging due to the variable levels of efficacy and complications seen in previous reports. Various vascular lasers have been utilized to treat PAE; however, most publications report on the effects only in active inflammatory acne.8 Laser treatments, including the 585 and 595-nm pulsed dye laser (PDL), the low-fluence 585-nm Q-switched Nd:YAG laser, and the 1550-nm fractional Erbium-glass laser, can be used to target dilated blood vessels and decrease the appearance of redness.9,10 The 585 and 595-nm lasers target oxyhemoglobin in blood vessels, while the 1550-nm wavelength targets water causing heat production and as a result, photothermal destruction of dermal vasculature.11-14 Intense pulsed light (IPL) provides a noncoherent polychromatic source of intense light ranging from 400 to 1200-nm. The vascular mode of IPL operates at 560-nm, which allows for more selective destruction of superficial vessels by allowing peak absorption of oxyhemoglobin at 577-nm.15 The 577-nm yellow laser was introduced more than 20 years ago for the treatment of diabetic retinopathy, but has only been utilized in the field of dermatology in the past 2 years.9,16-18 This laser emits 100% yellow light, which allows it to specifically target oxyhemoglobin in vascular lesions, but with less absorption in melanin and a slightly deeper penetration into the dermis, thereby minimizing the risk of hyperpigmentation especially in patients with darker skin types.9,15 The main chromophore for facial erythema is oxyhemoglobin which has three peak points—one at 418-nm, 542-nm and at 577-nm in visible light.9,15,17 Because of its ability to specifically target oxyhemoglobin, the 577-nm pro-yellow laser has been deemed ideal for vascular lesions by having an additional advantage over the copper bromide laser (composed of 90% yellow light and 10% green light) of minimizing risk of hyperpigmentation in patients of darker skin types. Other than this, other benefits of the 577-nm laser over the other lasers and energy-based devices include its ergonomic quality in that it does not require an expensive dye kit such as in the more widely used PDL, nor a cooling device or coupling gel such as in IPL.9 To date, there have only been three recent studies that have aimed to prove the efficacy of 577-nm pro-yellow laser in dermatologic conditions. The 577-nm laser has been a topic of interest in the treatment of port-wine stains (PWS), due to its relative advantage over the traditional 585 or 595-nm PDL for having less post-treatment downtimes, less risk for scarring, and postinflammatory erythema. In one such study done by Sarac in 2019, 26 patients with PWS were treated at 4-week intervals with F 24-44 J/cm2 on scan mode for 4-5 sessions.18 They concluded that the 577-nm laser can be considered a good alternative for superficial PWS lesions, but for deeper lesions, NdYAG lasers still produce better results. On the other hand, a study by Mohamed in 2019 looked into the effectiveness of the 577-nm laser not only for PWS birthmarks, but also for papulopustular rosacea, facial telangiectasia, and facial erythema, with the most success (63.6% of cases with excellent results) seen in the latter.17 The setting used to treat rosacea and facial

erythema patients ranged between F 12 and 16 J/cm2 with pulse duration from 20 to 26 ms, and was done at 1-month intervals for a maximum of 5 sessions. In may be noted that in the above-mentioned study, the laser parameters used for facial erythema are quite similar to the range used in this study (F 10-16 J/cm2, 30 ms). Another study by Kapicioglu in 2018 showed the efficacy and safety of the 577-nm pro-yellow laser in erythemotelangiectatic rosacea, facial erythema, and facial telangiectasias.9 Forty patients were treated for 1-4 sessions at 4-week intervals, initially using the screening (form) mode at F 22-28 J/cm2 and then later on using the 6mm spot mode at F 16-22 J/cm2. The study reported better success rates with less number of sessions for facial erythema than for facial telangiectasias. Only transient mild erythema immediately post-treatment was reported as an adverse effect. The differences in fluence used for this study and our study may be explained by the ethnicity and skin phototype of the enrolled patients. The objective of this study was to evaluate the efficacy and safety of 577-nm HOPSL in the treatment of postacne erythema in patients with skin type III-IV.

2 Materials and methods

The efficacy and safety of this novel 577-nm HOPSL in the treatment of PAE was evaluated in a split-face, randomized controlled trial pilot study. The study was conducted in a tertiary government hospital in Bangkok, Thailand. Twenty-four patients with PAE on both sides of their face were enrolled in this study. The participants' acne lesions were rated using a simple grading system.19 All patients included in the study were female or male volunteers aged >18 years old with presence of PAE on both sides of the face, >10 lesions/facial side and no actual acne or acne with only a grading score of ≤2. Exclusion criteria included pregnancy, patients who had previously been treated with isotretinoin or prednisolone within the past 3 months, those who have undergone chemical peels or laser treatments within the past month, and those who have applied topical tretinoin, benzoyl peroxide, or azelaic acid within the past 2 weeks. Left or right facial side of each individual patient was randomly assigned to either 577-nm HOPSL treatment (QuadroStar PRO™, Asclepion Laser Technologies) using the scanner handpiece, 1 mm spot size, 80% coverage, 12-15 J/cm2, 30 ms, 2 passes for 3 sessions at 1 month intervals, or to the no treatment group. The settings for the scanner handpiece were adjusted according to skin type to decrease the risk of postinflammatory hyperpigmentation, with mild erythema as an endpoint. This handpiece is originally intended for larger areas because of its integrated cooling system function, but was utilized in this study for increased patient comfort. Patients with Fitzpatrick skin type III were treated with F 14-16 J/cm2, Fitzpatrick skin type IV with F 12-14 J/cm2, and Fitzpatrick skin type V with F 10-12 J/cm2, all using the built-in 1 mm spot and a 30 ms pulse width. The erythema index (EI) and melanin index (MI) on 3 different areas of each side of the face were measured at baseline and 1 month after each treatment session using the Mexameter® TM 300, (Courage + Khazaka electronic GmbH). Board-certified dermatologists and the patient participant himself/herself also assessed the overall improvement at every visit by using 5-point scale (0 = worse, 1 = little improvement or not improved, 2 = fairly improved, 3 = improved, 4 = very improved). Side effects including pain, erythema, swelling, and crusting were likewise recorded. Paired t tests were used to compare mean changes in erythema indices and melanin indices at baseline, 1 month, 2 months, and 3 months. Data were analyzed using SPSS software (version 24.0; SPSS Inc). P-values of <.05 were considered statistically significant. This study was approved by the ethics committee of the Siriraj Institutional Review Board. Written informed consent was obtained from all participants prior to their enrollment in the study.

3 Results

Of all 24 volunteers enrolled in the study, 21 (5 males and 16 females) completed the trial for evaluation. Most of the participants had Fitzpatrick skin type IV (66.7%), followed by skin type III (23.8%) and skin type V (9.5%). The average age of subjects was 35 ± 3.5 years. At the end of the full treatment period (1 month after 3 treatments), the mean EI was significantly decreased in both treated and nontreated sides of the face ($P < .001$ and $P = .001$, respectively) when comparing to baseline. However, the laser-treated sides demonstrated significant reduction in the mean EI compared with nontreated sides at 1 month after 2 treatments ($P = .007$) (Figure 1). On the other hand, the mean MI of both sides was not statistically significant different from baseline and likewise did not show any significant difference when comparing between treated and nontreated sides. Patients reported to have more improvement on laser-treated sides as compared to nonlaser-treated sides at 1 month after 1st, 2nd, and 3rd treatment sessions ($P = .002$, $P = .001$, and $P < .001$) (Table 1, Figure 2). However, there was no statistically significant difference in overall improvement rated by blinded dermatologists at every visit ($P = .519$, $P = .776$, and $P = .882$) (Table 2). The inter-rater reliability between 2 blinded dermatologists was measured with concordance of 90%. Side effects from the treatment were limited to mild discomfort during treatment and transient facial erythema lasting 30 minutes.

4 Discussion

Postacne erythema (PAE) remains to be a therapeutic challenge as there are no reliable treatment guidelines available. Although some lesions may spontaneously improve over time, some may continue to last for 2-6 months12 or in some cases, complete clearance may not be achieved at all. Several laser modalities aiming to target dilated blood vessels have been utilized in the past to help improve the appearance of PAE. Nonablative fractional lasers and pulsed dye lasers (PDL) are effective in treating dermal vessels with minimal damage to the epidermis and have therefore been utilized previously in the treatment of PAE.13 However, given its characteristic nature of spontaneous resolution, the marginal benefits of using these laser procedures may be difficult to assess and quantify. There have been some notable studies in the past discussing promising laser treatment options for PAE. A split-face study done by Alster in 1996 aimed to compare the normal healing process of postacne erythema with 585-nm pulsed dye laser.10 In this study, 22 patients with erythematous and/or hypertrophic facial acne scars received 585-nm flashlamp-pumped PDL treatment on one cheek, while the other cheek was used as control. Patients showed 67.5% and 72.5% mean scar improvement after 1 and 2 laser treatments, respectively. Erythema measurements were also significantly lower than those obtained at baseline after 1 or 2 treatments; however, these were not significantly different from controls. This is the only paper that conducted a controlled trial using using the 585-nm laser and demonstrated the benefit of laser treatment over spontaneous resolution of PAE lesions.

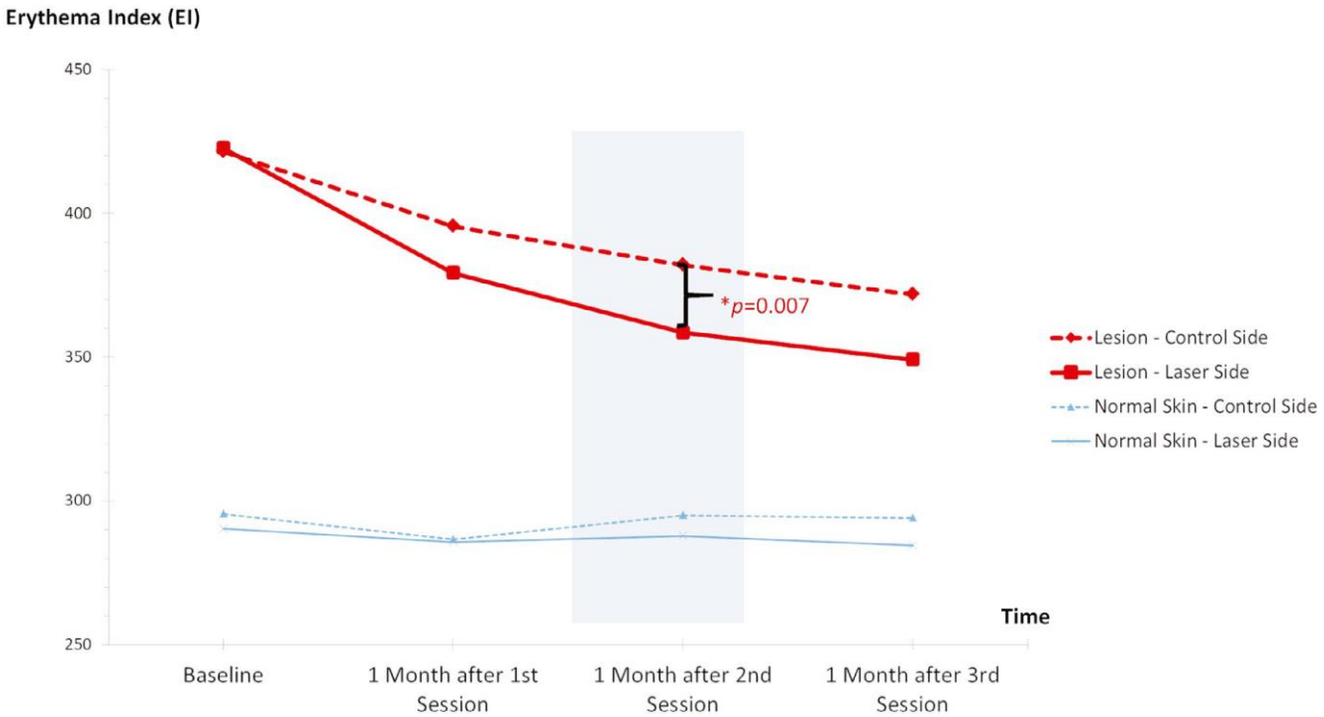

Figure 1: Graph showing significant reduction in mean erythema index on laser-treated side at 1 mo after 2 treatments when comparing to control side

	Laser	Control	P-value
1 mo after 1st session	2.1	1.2	.002
1 mo after 2nd session	2.3	1.3	.001
1 moth after 3rd session	2.3	1.3	<.001

Table 1: The weighted overall improvement score rated by patients (0 = not improved, 1 = <25% improvement, 2 = 25%-50% improvement, 3 = 51%-75% improvement, 4 = >75% improvement

A study done by Panchaprateep in 2015 evaluated the safety and efficacy of a low-fluence 585-nm Q-switched Nd:YAG laser in 25 patients with PAE.12 Significant reduction in PAE lesions counts and erythema indices was seen after 3 sessions at 2-week intervals. Another interesting study done by Park in 2014 compared a fractional nonablative 1550-nm laser and 595-nm pulsed dye laser in the treatment of PAE and showed slightly better outcomes with the 1550-nm Erbium-glass fractional laser which they proposed could be due to the better penetration into deeply located blood vessels.13
This is the first study to show the effectiveness of a 577-nm HOPSL laser in the treatment of PAE. In all of the patients enrolled, better outcomes in terms of decreased erythema indices were seen on the treated side (17% decrease in EI) compared with controls (11% decrease in EI), which was more remarkable at 1 month after 2 treatment sessions. No significant changes were seen in terms of the melanin index from baseline as well as in between treatment and nontreatment sides, which may possibly indicate a low risk of development of postinflammatory hyperpigmentation from this treatment. The greatest limitation of this study is its inability to measure the marginal benefit or receiving this laser treatment when weighed against the cost of the procedure for the patient. Given the nature of spontaneous resolution of the lesions as discussed, the cost-effectiveness of utilizing the 577-nm HOPSL laser has not been taken into consideration in this study. This study has demonstrated, however, that laser-treated sides still produced better outcomes than the nontreated sides which also

demonstrated gradual fading of erythema. Other limitations of the study are the following. First, due to the nature of the treatment procedure performed, blinding of patients cannot be done. The evaluation for improvement by the blinded dermatologists and nonblinded patients may not correspond to each other, which could be attributed to information bias. Patients consistently reported good outcomes after every visit, which was not reflected in the raters' assessment. Secondly, a longer follow-up period of up to 6 months may be more beneficial to see the maximum effect of laser treatments and its advantage over nontreatment.

5 Conclusion

In conclusion, the 577-nm HOPSL provided better outcomes with minimal to no side effects after only 2 treatments when compared to controls. Due to a higher peak absorption of oxyhemoglobin at this wavelength, better effects can be achieved at a lower fluence thereby minimizing the chances of PIH. It provides greater patient comfort and less downtime post-treatment and should therefore be considered an alternative to nonablative fractional lasers and pulsed dye lasers in the treatment of PAE. In addition, the use of this laser carries an additional benefit for its ergonomic design and relative cost-effectiveness. These promising results, however, should be further verified in future studies with longer follow-up periods and a larger sample size.

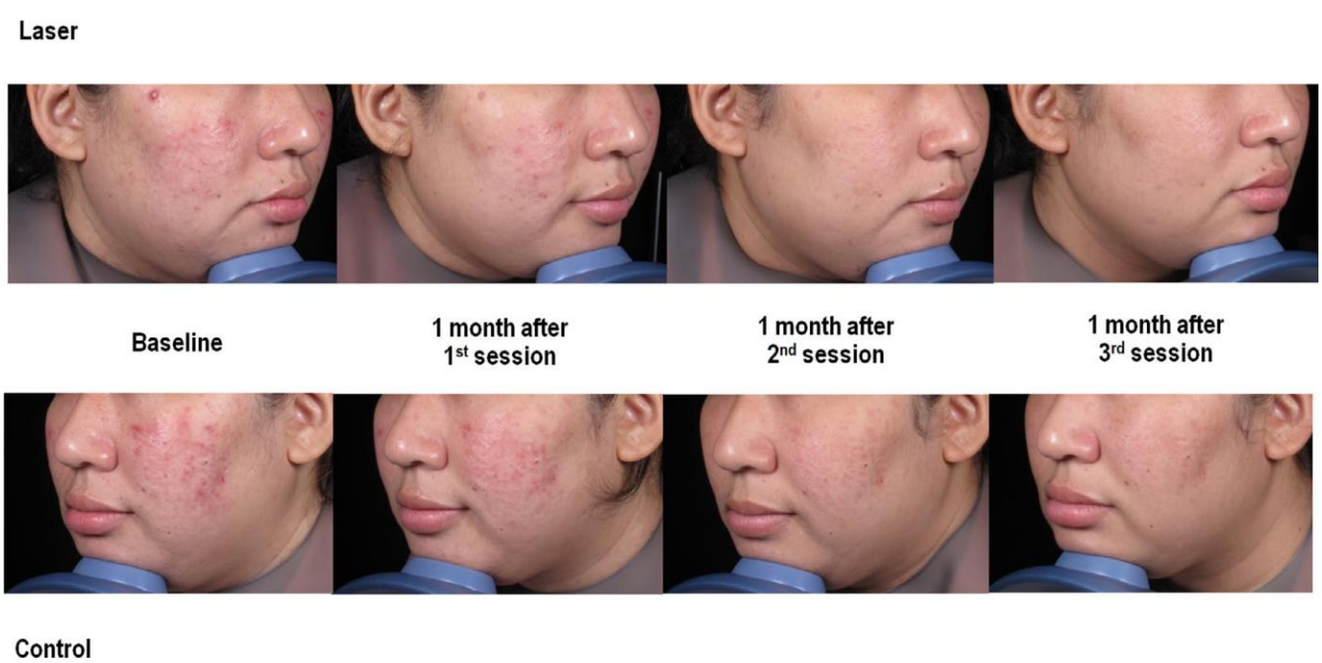

Figure 2: Clinical photographs comparing treated and nontreated sides at baseline and 1 mo after the 1st, 2nd, and 3rd session

	Laser	Control	P-value
1 mo after 1st session	1.9	1.7	.519
1 mo after 2nd session	2.6	2.5	.776
1 mo after 3rd session	3.1	3.1	.822

Table 2: The weighted overall improvement score rated by blinded dermatologists (0 = not improved, 1 = <25% improvement, 2 = 25%-50% improvement, 3 = 51%-75% improvement, 4 = >75% improvement)

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Conflict of interest
The authors have no relevant financial interest in this article.

Authors contributions
Dr Wanitphakdeedecha had full access to all of the data in the study and takes responsibility for the integrity of data and the accuracy of the data analysis, and involved in study concept and design. Drs. Wanitphakdeedecha, Ungaksornpairote, Kobwanthanakun, Phothong, and Eimpunth involved in acquisition of data. Drs. Wanitphakdeedecha, Ungaksornpairote, and Kobwanthanakun analyzed and interpreted the data. Drs. Cembrano, Fritz, and Salavastru drafted the manuscript. Dr Manuskiatti critically revised the manuscript for important intellectual content. Dr Ungaksornpairote statistically analyzed the study. Dr Manuskiatti served as administrative, technical, or material support. Dr Manuskiatti supervised the study.

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Successful treatment of facial vascular skin diseases with a 577-nm pro-yellow laser

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Abstract

Background: Treatment of vascular skin diseases is one of the most important indications of the laser.
Aims: To evaluate the effectiveness of 577-nm pro-yellow laser in the treatment of some vascular skin diseases.
Patients/methods: Ninety-five patients with vascular skin diseases were included in this prospective monocentric study. They were classified into: port-wine stain birthmarks (n = 37), papulopustular rosacea (n = 20), facial telangiectasia (n = 16), and facial erythema (n = 22). All participants received a monthly session of 577-nm pro-yellow laser. Follow-up was done by comparing the photographs before and at every follow-up visit. Results: At the final visit, there was a significant improvement (>50%) occurred in 24/37 (64.82%), 12/20 (60%), 10/16 (62.5%), and 19/22 (86.3%) cases and poor response occurred in 6/37 (16.2%), 2/20 (10%), 2/16 (12.5%), and 0/22 cases after a mean number of sessions 7.76 ± 2.28, 3.1 ± 1.8, 3.63 ± 1.12, and 1.8 ± 0.85 in portwine stain, rosacea-, facial telangiectasia-, and facial erythema-treated groups, respectively. Transient irritation and erythema during the session were the only complications reported in the study.
Conclusion: Facial port-wine stains, rosacea, telangiectasia, and erythema can be successfully treated with a single pass of 577-nm pro-yellow laser with a minimal side effect. Facial erythema showed the highest degree of success with the least number of sessions, while more sessions needed for the treatment of port-wine stain.

1 INTRODUCTION

A vascular anomaly is a localized defect in blood vessels caused by a disorder of vascular development, although it is not always present at birth.[1] Vascular anomalies can occur throughout the whole body but in 60% of patients it is localized in the head and neck region and appears as red color stains.[2,3] Laser treatment of vascular lesions remains one of the more common applications of lasers in dermatology. In fact, lasers have largely become the treatment of choice for vascular birthmarks such as hemangiomas and port-wine stains (PWS) and erythematotelangiectatic rosacea.[4]
The main intravascular chromophores are oxyhemoglobin, deoxygenated hemoglobin, and methemoglobin. Absorption peaks for oxyhemoglobin are 418, 542, and 577 nm, while deoxyhemoglobin ranges from 800 to 1200 nm.[4-6]
Vascular laser targets intravascular oxyhemoglobin to effect the destruction of various congenital and acquired vascular lesions. Common types of laser used to treat vascular lesions include the argon (488-514 nm), APTD (577 and 585 nm), KTP (532 nm), krypton (568 nm), copper vapor/bromide (578 nm), PDL (585-595 nm), and Nd:YAG (532 and 1064 nm).[7]
Pulsed dye laser (PDL) was the early laser used in the treatment of PWS lesions based on the theory of selective photothermolysis.[8] However, it is difficult to obtain complete clearance despite multiple PDL treatments.[9] The pro-yellow laser, at 577 nm, has an ideal wavelength for treating cutaneous vascular disorders.[10]

The aim of this study was to determine the effectiveness of 577-nm pro-yellow laser in the treatment of PWS, papulopustular rosacea, facial telangiectasia, and facial erythema.

2 PATIENTS AND METHODS

This is a prospective study carried out after being approved by the Ethical Committee of Al-Azhar University. Participants in this study (n = 95) were patients with facial vascular skin disorders: 37 patients with port-wine stain, 16 patients with facial telangiectasia, 20 patients with papulopustular rosacea, and 22 patients with facial erythema. Written and oral informed consent was obtained from all participants prior to enrollment.
Exclusion criteria were patients aged <18 years, pregnant women, patients with active herpes simplex infection, personal history of skin cancer or radiotherapy or photodermatosis, patients received topical or systemic retinoid treatment in the past 3 months, and patients with a history of postinflammatory hyperpigmentation, keloid, or hypertrophic scars and with previous laser treatment.

2.1 Treatment protocols

Prior to treatment, the patients asked to remove any makeup or powder. Most patients do not require local anesthesia before the session; however, topical anesthetic cream applied before the treatment for patients cannot tolerate the irritation. During treatment, the patient and physician wear specific goggles to guard against the harmful effects of laser on eyes. The treatment was performed at 1-month intervals and carried out with a single pass of 577-nm pro-yellow laser (QuadroStar PRO YELLOW® Asclepion Laser Technologies), and the wavelength used was 577 nm. In portwine stain-treated and telangiectasia-treated patients, fluence was started from 17 J/cm^2 and increased gradually until 22 J/cm^2 according to tolerance of the patients and pulse duration range from 20 to 32 ms according to skin phototype, while in rosaceaand facial erythema-treated patients, low fluence was used starting from 12 J/cm^2 up to 16 J/cm^2 with pulse duration ranging from 20 to 26 ms. Immediately after the session, the ice pack was applied to the treated area for 5 minutes followed by application of sunscreen with SPF more than 30. The patient advises avoiding sun exposure with regular use of sunscreen and emollient. The number of sessions is varied between groups, and up to 10 sessions are needed for significant lightening in PWS and maximum five sessions in other groups. The assessment of the treatment was based on clinical examination and by standardized digital photographs using a camera (Nikon Coolpix S2500 12 MP) at baseline and 1 month after the last treatment. Improvement was rated as follows: excellent (75%-100%), very good (50%-74%), good (25%-49%), and poor (<25%). Also, the development of any side effects during or after the session was recorded.

2.2 Statistical analysis

SPSS version 21 program was used for data processing. Categorical variables were described by the number and percent (N, %), where continuous variables were described by mean and standard deviation (mean, SD). Statistical evaluation of the data was conducted with the Pearson chi-square test and Fisher's exact chi-square test. P-values <0.05 were considered significant.

TABLE 1 Characteristics of studied patients

	Port-wine stain (n = 37)	Papulopustular rosacea (n = 20)	Facial telangiec-tasia (n = 16)	Facial erythema (n = 22)
Age/years Range (mean ± SD)	18-43 (19.3 ± 7.72)	23-38 (24.7 ± 8.01)	26.5-41 (28.5 ± 7.67)	26.5-41 (22.3 ± 3.04)
Gender: N (%)				
Male	6 (18.4%)	4 (20%)	2 (12.5%)	7 (31.8%)
Female	31 (81.6%)	16 (80%)	14 (87.5%)	15 (68.2%)
Skin phototype				
II	1 (2.7%)	2 (10%)	1 (6.25%)	1 (4.6%)
III	2 (5.4%)	6 (30%)	2 (12.5%)	5 (22.7%)
IV	34 (91.9%)	12 (60%)	13 (81.25%)	16 (72.7%)
Number of sessions Mean ± SD	7.76 ± 2.28	3.1 ± 1.8	3.63 ± 1.12	1.8 ± 0.85

3 RESULTS

The final study cohort was made up of 95 patients with vascular skin diseases divided into four groups: patients with PWS (n = 37), patients with papulopustular rosacea (n = 20), patients with facial telangiectasia (n = 18), and patients with facial erythema (n = 22). The data of the studied groups are represented in Table 1.

At the final visit, there was excellent improvement in portwine stain-treated group in 10 (27.02%) cases, very good improvement in 14 (37.8%) cases, good improvement in 7 (18.9%) cases, and poor improvement in 6 (16.2%) cases (Figure 1A,B). In facial telangiectasia-treated patients; there was excellent improvement in 4 (25%) cases, very good improvement in 6 (37.5%) cases, good improvement in 4 (25%) cases, and poor improvement in 2 (12.5%) cases (Figure 2A,B). In rosacea-treated patients, there was excellent improvement in 8 (40%) cases, very good improvement in 4 (20%) cases, good improvement in 6 (30%) cases, and poor improvement in 2 (10%) cases (Figure 3A,B). In patients with facial erythema, there was excellent improvement in 14 (63.6%) cases, very good improvement in 5 (22.7%) cases, and good improvement in 3 (13.6%) cases (Figure 4A,B; Table 2). Transient irritation during the session and transient erythema after the session disappeared within 2 days was the only complications reported in our study. There was no significant relationship between the improvement of PWS after the treatment and patient's ages, sex, duration of PWS, skin phototypes, or site of the lesions.

4 DISCUSSION

The light energy of pro-yellow laser is 100% 577-nm yellow light, which is ideal wavelength for the treatment of vascular lesions compared with copper bromide laser, which has the closest wavelength to the pro-yellow laser but contains two wavelengths (90% yellow light and 10% green light) which carry the risk of postinflammatory hyperpigmentation.[11] The pure yellow light in pro-yellow laser allows it to use in the treatment of vascular lesions especially in patients with dark skin with minimal risk of side effects.[10]

Port-wine stains is the most common of all congenital vascular malformations and presented histologically in the form of ectatic dilation of a normal number of postcapillary venules in the papillary dermis.[12-14] However, there are several treatment options available for PWS; vascular-specific lasers are the main line in treating PWS.[15]

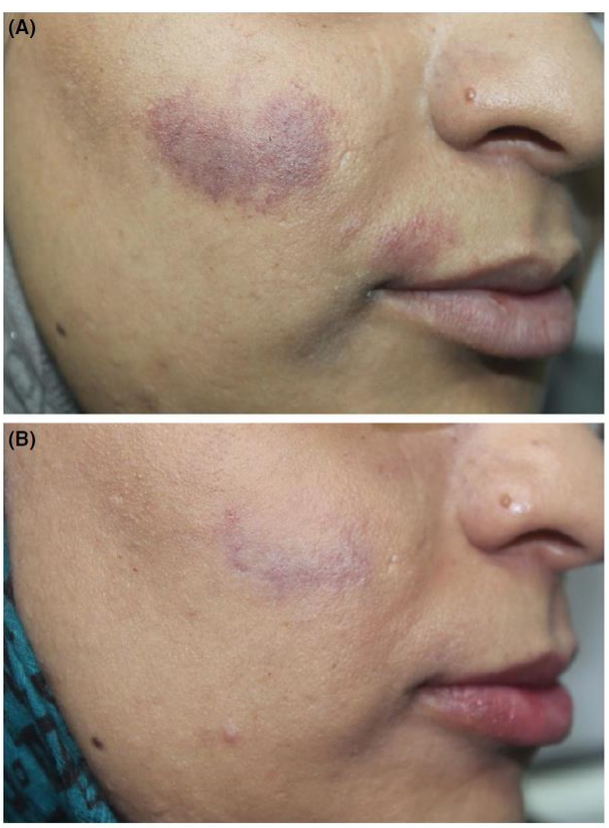

FIGURE 1 A 37-year-old female with port-wine stain (A) before treatment and (B) 4 wk after 10 sessions of a 577-nm pro-yellow laser with excellent improvement

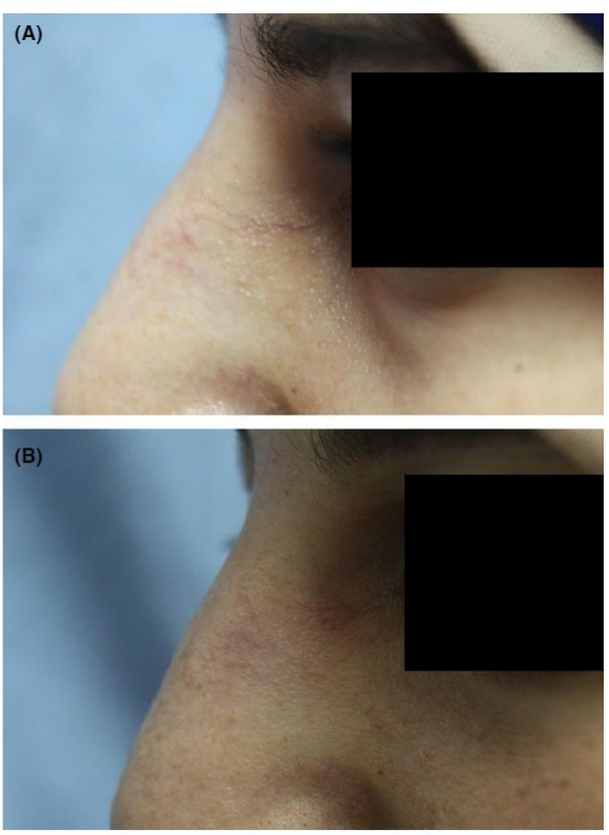

FIGURE 2 A 29-year-old female with facial telangiectasia (A) before treatment and (B) 4 wk after three sessions of 577-nm pro-yellow laser with excellent improvement

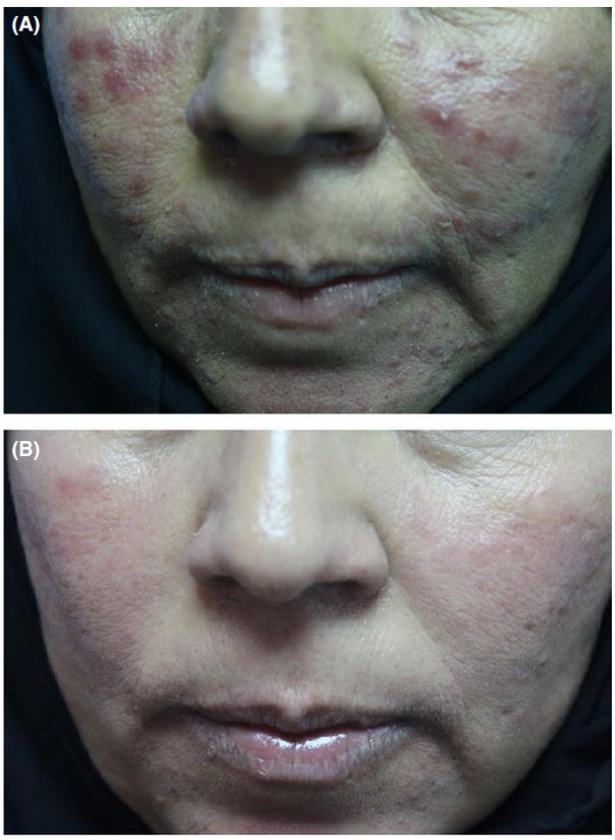

FIGURE 3 A 48-year-old female with papulopustular rosacea (A) before treatment and (B) 4 wk after three sessions of 577-nm pro-yellow laser with excellent improvement

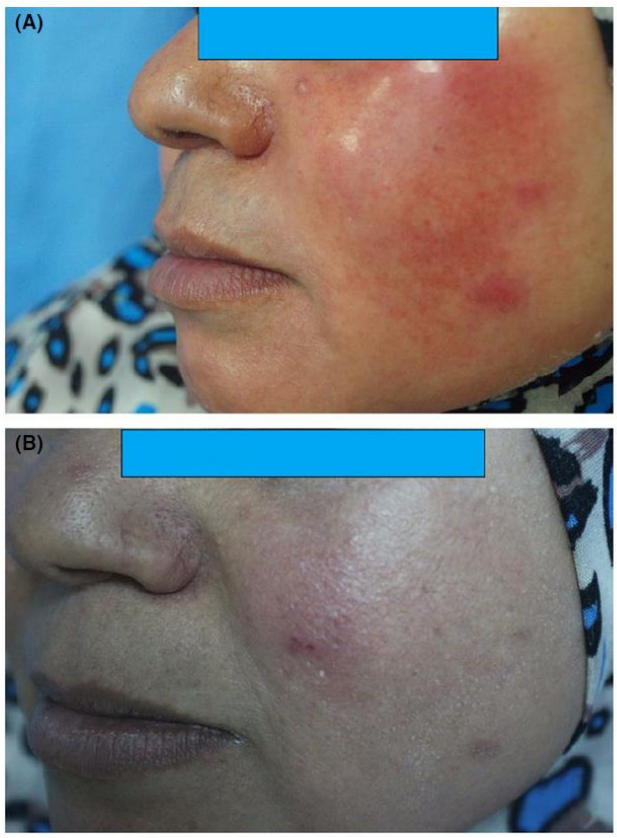

FIGURE 4 A 34-year-old female with facial erythema (A) before treatment and (B) 4 wk after two sessions of 577-nm pro-yellow laser with excellent improvement

The previous study about the efficacy of 577-/585-nm PLD laser in the treatment of port-wine stain showed that complete clearance occurred in 25% of patients, 70% showed 50% or more lightening, whereas 20%-30% respond poorly.16 However, little was published about the efficacy of 577-nm pro-yellow laser in the treatments of PWS. In this study, we found that there is a significant improvement (>50%) in PWS after the treatment with a single pass of 577-nm proyellow laser occurred in about 64.5% patients and poor response occurred in 16.2% patients.

The efficiency of laser treatment depends on many factors: Better response can be achieved in younger age, purple lesion color, and superficial and smaller vessels.[6] The poor response in some patients may occur due to the dynamic nature of vascular chromophore and variation in size, depth, and intimal thickness of blood vessels.[17]

Facial telangiectasia is a common cause of cosmetic concern. Both lasers and light sources are safe and effective methods for the treatment of facial telangiectasia, and the outcome of the treatment depends on the size and shape of the telangiectatic vessels.

In the present study, there is a significant improvement in about 60% of patients with papulopustular rosacea and facial telangiectasia after the treatment with a single pass of 577-nm pro-yellow laser. Numerous studies and large case series confirmed the safety and efficacy of LPDL (595 nm) and KTP (532 nm) lasers as well as IPLs for the removal of facial telangiectasia with at least 50-90% improvement after 1-3 treatments.[18-25]

TABLE 2 Improvement of vascular skin diseases after the treatment with diode 577-nm laser

	Port-wine stain (n = 37)	Rosacea (n = 20)	Facial telangiectasia (n = 16)	Facial erythema (n = 22)
Excellent (≥75%)	10 (27.02%)	8 (40%)	4 (25%)	14 (63.6%)
Very good (≥50%-74%)	14 (37.8%)	4 (20%)	6 (37.5%)	5 (22.7%)
Good (≥25%-49%)	7 (18.9%)	6 (30%)	4 (25%)	3 (13.6%)
Poor (<25%)	6 (16.2%)	2 (10%)	2 (12.5%)	

A single recent case series study reported that success rate 83.63% after the treatment of facial telangiectasia with 577-nm pro-yellow laser with a mean number of sessions was 3.36. The higher success rate in this study may be due to high fluence used as most of the patients were fair skin, while in our study, most of our patients are dark skin and low fluence was used.

No side effect was observed except for a few patients who had mild to moderate erythema fading away in 12-24 h after the treatment with 577-nm pro-yellow laser-10. Also, in our study, irritation and transient erythema were the only side effects reported by the patient; however, it is individual variation, can be tolerated, and usually occur during the first few sessions especially in high fluence and disappears during subsequent sessions.

Although the outcome of the treatment of vascular laser depends on many factors as patient's ages, skin phototype, and site of the lesions,[6] our study demonstrated that there is no significant relationship between the improvement after the treatment with 577-nm pro-yellow laser and patient's ages, sex, duration of port-wine stains, skin phototypes, or site of the lesions.

5 CONCLUSION

We concluded from this study that a single pass of 577-nm pro-yellow can be used successfully in the treatment of facial PWS, papulopustular rosacea, facial telangiectasia, and facial erythema with minimal side effects. Facial erythema responds after few number of sessions, while in PWS more sessions are needed.

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Treatment of erythematotelangiectatic rosacea, facial erythema, and facial telangiectasia with a 577-nm pro-yellow laser: a case series

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ABSTRACT

Various lasers have been used for the treatment of erythematotelangiectatic rosacea (ETR), facial erythema (FE), and facial telangiectasias (FT). The assessment of the treatments of all of these conditions with a 577-nm pro-yellow laser has not been reported yet. The aim of this work was to assess the efficacy and safety of the 577-nm pro-yellow laser in ETR, FE, and FT. Forty patients suffering from ETR, FE, and FT (25 female and 15 male) were enrolled in this study. All of the patients were treated with 577-nm pro-yellow laser (QuadroStarPRO YELLOW®Asclepion Laser Technologies, Germany) at 4-week intervals, for one to four sessions. The assessment of the treatment was made based on the digital photographs and the percentage of fading of the erythema and telangiectasias in the lesions. Significant clinical improvement (80–100%) was observed in the first or second sessions of the treatment in FE and ETR patients and in second and fourth sessions of the treatment in FT patients. The treatment was very well tolerated. No side effect was observed except for a few patients who had mild to moderate erythema fading away in 12–24 h. This case series has shown that the pro-yellow laser is a very effective, safe, and well-tolerated treatment for ETR, FE, and FT.

Introduction

Facial telangiectases (FT) are small-dilated vessels that are visible on the skin surface. They can vary in size (0.1–3 mm diameter), location, color (bluish to reddish), and pattern. Many patients have a genetic predisposition to facial telangiectases, while in others it is associated with various disorders, such as rosacea, connective tissue diseases, increased estrogenic states, liver disease, photodamage from sun exposure, prolonged steroid use, etc. They are a cosmetic disfigurement for millions of people, and since they are difficult to hide with makeup, cosmetic disfigurement is the most common presenting symptom [1, 2].

The pro-yellow laser, at 577 nm, has an ideal wavelength for treating cutaneous vascular disorders. Immediate blanching of the lesion is used as a clinical indicator of thermal damage and appropriate dose.

Various lasers have been used for the treatment of ETR, FE, and FT [3–5]. However, treatments of all of these conditions with a 577-nm pro-yellow laser have not been reported yet. The aim of this work was to assess the efficacy and safety of the 577-nm pro-yellow laser in ETR, FE, and FT.

Material–method

Patient selection

The study was conducted retrospectively. A total of 40 patients who were seen at our dermatology department with facial telangiectasia (FT), facial erythema (FE), and facial erythema-telangiectasia or

erythematotelangiectatic rosacea (ETR) and then treated with the pro-yellow laser were retrospectively evaluated. The patients were diagnosed with a clinical examination and detailed history. No biopsy was taken from any patient for the diagnosis. The 40 patients consisted of 25 females and 15 males with a mean age of 38 (18–60) years. The skin type was Fitzpatrick II-III. Written consent. was obtained from the patients and the study complied with the Helsinki Declaration.

Laser treatment

Topical anesthesia (2.5% lidocaine hydrochloride and 2.5% prilocaine [both w/v] [EMLA]; AstraZeneca, Södertalje, Sweden) was administered to the planned laser area approximately 30 min before the treatment. Cold application was used and the area was cleaned with octenidine dihydrochloride solution before the treatment. One to four sessions of pro-yellow laser applications at 577 nm were used for all patients with treatments taking place every 4 weeks. The first session was started with 22 J/cm^2 on average and the dose increased a mean value of 2 J/cm^2 at each session to a maximum of 28 J/cm^2. All sessions were started in the screening (form) mode. The spot mode of 6 mm was applied at the second and third sessions for FTs. The spot mode was started at 16 J/cm^2 and increased to a maximum of 22 J/cm^2. The procedure was followed by cold application for about 30 min. The patients were recommended to use sun protection cream regularly.

Evaluation of the patients

Digital photographs were taken of the areas with a lesion before and 4 weeks after the laser treatment and the results were evaluated by two different observers. The patient was accepted to have been cured if there was an improvement of 80% or more. The improvement rate of erythema and telangiectasia was considered to be the criteria for improvement and all the patients were observed for any scatris formation, postinflammatory hyperpigmentation, and hypopigmentation development as possible complications in the treated parts of the face.

Statistical evaluation

The SPSS for Windows Version 22.0 software was used for the statistical evaluation of the study data. Mean (X) ± standard deviation (SD) was used for the data regarding quantitative variables and number (n) and percentage (%) for qualitative data. Statistical evaluation of the data was conducted with the Pearson chi-square test and Fisher's exact chi-square test. A p value < 0.05 was accepted as statistically significant.

Results

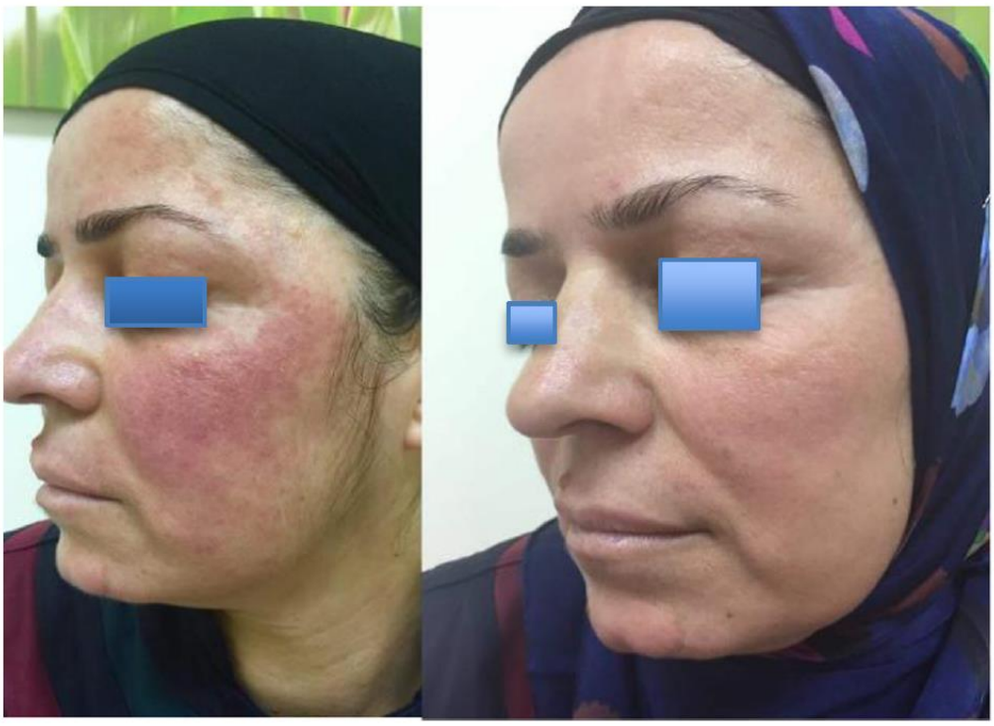
A total of 40 patients were included in the study. The demographic characteristics revealed that there were 25 females (62.5%) and 15 males (37.5%) with a mean age of 38.7 ± 9.9 (18–60 years). Skin type evaluation revealed 15 Fitzpatrick II and 25 Fitzpatrick III patients.
The diagnosis was FE in 13 patients, FT in 11 patients, ETR in 7 patients, and facial erythema + facial telangiectasia in 9 patients. The success rate with the laser was highest in patients with facial erythema but lower in the FT patients than the others. Besides, the mean number of laser sessions

was also lower in facial erythema. The patient distribution and success rate based on the sessions are presented in Table 1.
Pre- and posttreatment pictures of the FE (Fig. 1), FT + FE (Fig. 2), and ETR (Fig. 3) patients have been presented.
Skin type evaluation revealed 15 Fitzpatrick II and 25 Fitzpatrick III patients. The success rate of laser treatment in terms of skin type was 92% for Fitzpatrick II and 87% for Fitzpatrick III and is presented in Table 2.
Evaluation of lesion location by gender showed no statistically significant difference for the forehead and cheek areas ($p = 0.722$, $p = 1.00$, respectively) but the rate of nasal involvement was statistically significantly higher in males than females ($p = 0.008$). Table 3 presents nasal area involvement rates by gender.
Chin area involvement was also statistically significantly higher in males ($p = 0.007$).Table 4 Presents chin involvement rates by gender.
Evaluation of the facial area affected by disease type showed statistically significantly higher forehead area involvement in ETR than in the other disorders ($p = 0.006$). The cheek area was the most commonly affected area in all four disorders at 100% of FE patients, 72.7% of FT patients, 100% of ETR patients, and 100% of FE + FT patients).
The highest ratio of nasal involvement was in the FT patients and Table 5 presents the nasal involvement rates based on disease type.
The chin involvement rate was highest in ETR and there was no patient with chin involvement in FT. The chin involvement rate was 38.5% in FE, 0% in FT, 57.1% in ETR, and 44.4% in FE + FT.
There was no statistically significant difference in terms of forehead, cheek, and chin involvement according to skin type ($p = 0.091$, $p = 1.0$, $p = 0.433$, respectively) but nasal involvement was statistically significantly more common in patients with the Fitzpatrick II skin type compared to Fitzpatrick III ($p = 0.008$).

Table 1 The patient distribution and success rate

Disorder type	Success rate (%)	Number of mean session	Success rate after 1st session (%)	Success rate after 2nd session (%)	Success rate after 3rd session (%)	Success rate after 4th session (%)
FE	95.38	1.53	87.6	95.0	100.0	
FT	83.63	3.36	66.3	73.7	86.0	100
ETR	91.42	3.14	71.4	81.4	91.4	
FE + FT	85.5	2.22	76.6	82.5	90.6	93.3

Fig. 1 Patient with FE is recovering after two sessions



There were no any complications of laser treatment such as atrophic scatris formation, postinflammatory hyperpigmentation, and hypopigmentation in the patients except a mild erythema persisting approximately 60 min after the treatment.

Fig. 2 Healing of the patient with FE + FT at the end of the third session

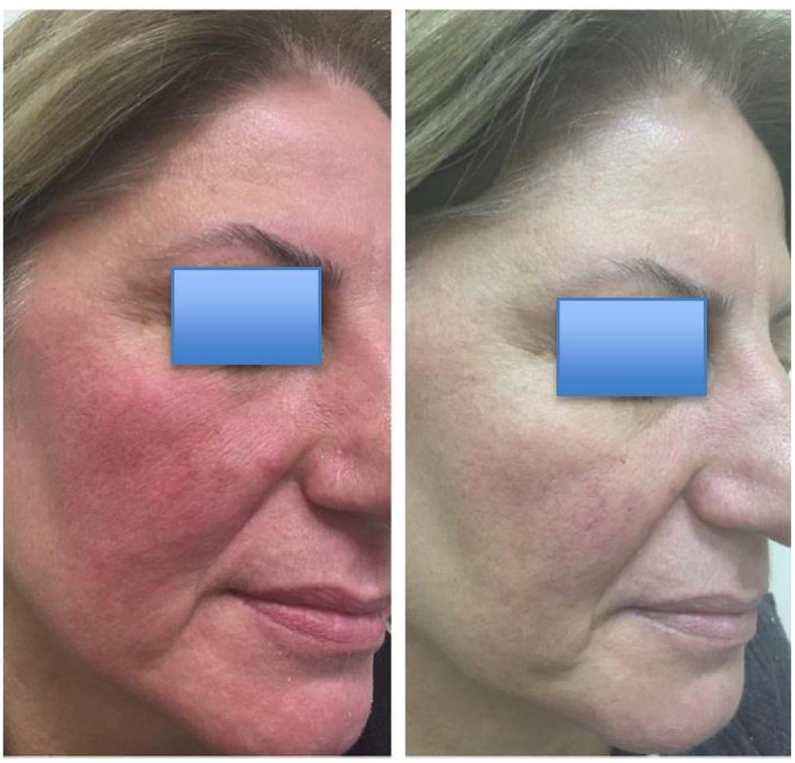
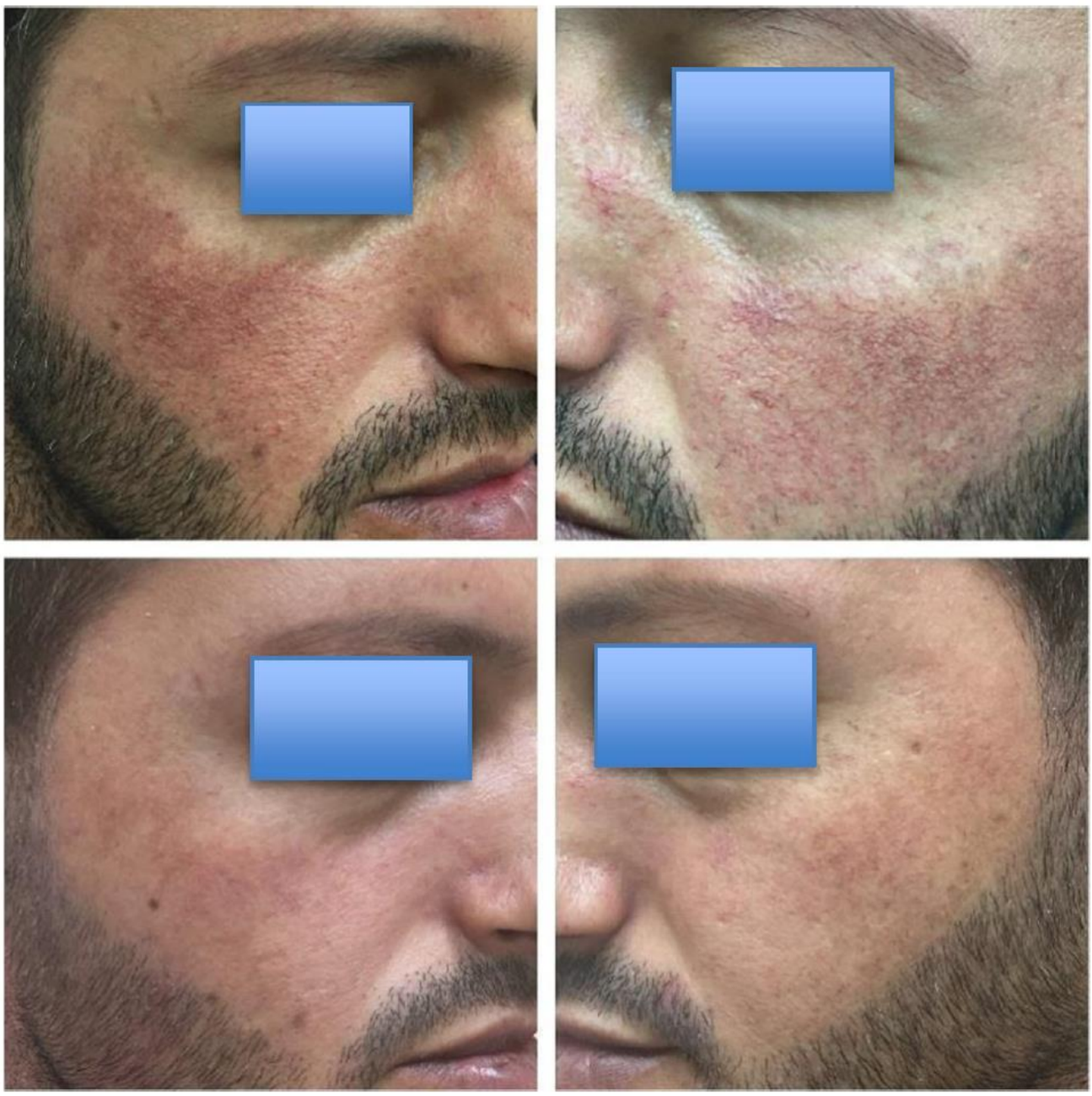


Fig. 3 Improvement of ETR patient after the fourth session



Discussion

FT lesions vascular structures that appear in various sizes, colors (purple, red, pink), and shapes (linear, arborizing, random) at various locations. Although etiological factors include rosacea, systemic or topical corticosteroid use, and connective tissue disorders, most cases are idiopathic. They usually develop due to genetic factors and sun exposure during childhood and in patients with Fitzpatrick I or II skin types [1]. FE and ETR are thought to develop following a pathological vasomotor reaction due to various stimulants. Although topical oxymetazoline and brimonidine can be used for treatment, these agents can cause rebound erythema and laser treatment is preferred [6]. These disorders affect

millions of people worldwide both physically and psychologically and their treatment has been an important issue in dermatology. Recent technological advances in the field of lasers have enabled better results and lower complication rates than the other treatment methods, significantly improving treatment options [7].

The main chromophore in facial telangiectasia and facial erythema is hemoglobin. Hemoglobin absorption has two main peak points at 542 nm and 577 nm in visible light. Various laser systems (Argon laser, Krypton lasers, Potassium-titanyl-phosphate (KTP) lasers, pulsed dye lasers, etc.) have been reported to be effective in the treatment of facial telangiectasia and erythema [8]. However, some of these have caused significant side effects following FT or FE treatment. For example, hypopigmentation and pitted-depressed scars have been reported after the Argon laser [9], bullae, crusts, periorbital erythema, edema, and posttreatment hyperpigmentation after the Krypton laser, and bruising, erythema, hyperpigmentation, and atrophic scars after PDL treatment [10, 11]. An attempt is being made to minimize these laser adverse effects with technological advances.

Table 2 Success rate according to sessions according to skin type

Skin type	Success (%)	Average session	Success rate after 1st session (%)	Success rate after 2nd session (%)	Success rate after 3rd session (%)	Success rate after 4th session (%)
Fitzpatrick II	92	2.06	80.6	83.3	98.3	100
Fitzpatrick III	87.6	2.28	74.0	82.0	86.0	90

Table 3 Nasal involvement by gender

Gender	Nose involvement (−) (*n*)	Nose involvement (+) (*n*)	Total (*n*)
Female	14 (% 56)	11(% 44)	25
Male	2 (% 13.3)	13 (% 86.7)	15

The recent pro-yellow laser only has a yellow light wavelength. The light energy is 100% 577 nm yellow light. This wavelength is ideal for vascular lesions. The copper bromide laser has the closest wavelength to the pro-yellow laser but contains two wavelengths with 90% yellow light and 10% green light [4]. However, the green light of the copper bromide laser has been associated with adverse effects and is thought to be the main factor in the low success rate in patients with dark skin color and resultant post-inflammatory hyperpigmentation. The fact that the pro-yellow laser only has yellow light wavelength presents several advantages in the treatment of vascular lesions such as the possibility of use in patients with dark skin, minimal risk for hyperpigmentation or scar development, and short duration of posttreatment erythema.

We did not come across any other report in the literature on the use of the pro-yellow laser for facial vascular lesions. There are reports of the successful use of the copper bromide laser, which has the closest wavelength to pro-yellow, in FT treatment. Owen et al. [2] divided facial telangiectasia lesions into three groups according to size in the study they conducted with the copper bromide laser. Fine telangiectasia in the cheek area and thick telangiectasia in the nose area were found to be resistant to the treatment. The size, location, and depth of the vascular structure and the blood flow rate were factors influencing the success of the laser treatment. Another study with the copper bromide laser reported the location of the vascular lesions to affect the response to treatment. The success rate was lower in lesions located in the nasal area and vascular lesions thicker than 300 nm, requiring a larger number of sessions. Erythema and edema continuing for about 48 h developed in the eyelid and neck area [1]. Another disadvantage of copper bromide laser system is that the equipment system is very big and heavy [12].

We found a higher rate success with a smaller number of sessions when treating facial erythema in our study while the facial telangiectasia group was the most resistant to treatment. We found no significant treatment-related adverse effects. A mild erythema continuing for approximately 60 min after the sessions was the most common adverse effect and did not cause loss of work or prevent social activities in any of the patients. We had no patient discontinuing the treatment due to adverse effects. However, we did not classify the vascular structures by size.

Table 4 Chin involvement by gender

Gender	Chin involvement (−) (*n*)	Chin involvement (+) (*n*)	Total (*n*)
Female	13 (% 52)	12(% 48)	25
Male	14 (% 93.3)	1(% 6.7)	15

Table 5 The nasal involvement rates based on disease type

Disorder type	Nose involvement (−) (*n*)	Nose involvement (+) (*n*)	Total (*n*)
FE	8 (% 61.5)	5 (% 38.5)	13 (% 100)
FT	1 (% 9.1)	10 (% 90.9)	11 (% 100)
ETR	3 (% 42.9)	4 (% 57.1)	7 (% 100)
FE + FT	4 (% 44.4)	5 (% 55.6)	9(% 100)

Other laser systems effective in the treatment of vascular lesions are the pulsed dye laser and the intense-pulsed light (IPL) system. However, erythema, purpura, edema, and serous crusting continuing for about 10 days can be observed with the pulsed dye laser. These adverse effects are usually not acceptable for the patients. Hypopigmentation and hyperpigmentation are other common side effects, especially in individuals with dark skin [13]. Besides good results with IPL, there are some disadvantages also such as the large spot width decreasing the opportunity to use in small lesions and the lack of simultaneous observation of the treated area as contact cooling systems are required for epidermal protection [14].

Many other types of laser have been used for the treatment of facial erythema and facial telangiectasia and reported to be effective. However, the cost and ergonomics of the laser device are also important. The pro-yellow laser does not require the dye used in pulsed dye laser systems or the gel used in IPL laser systems. It also does not require a large and heavy system as for the copper bromide laser or a cooling apparatus as in the IPL laser system.

In conclusion, we believe that the pro-yellow laser, with the advantages of a high success rate with a low number of sessions and mild or no adverse effects is an effective alternative in the treatment of FE, ETR, and FT. Our findings need to be supported with studies on a larger series of patients.

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Treatment of superficial vascular lesions with the KTP 532-nm laser: experience with 647 patients

Becher GL, Cameron H, Moseley H. Lasers Med Sci. 2014 Jan;29(1):267-71. doi: 10.1007/s10103-013-1330-5. Epub 2013 Apr 30.

ABSTRACT

Superficial vascular lesions are a common dermatological diagnosis but are often difficult to treat. Numerous lasers (especially the dye laser) and intense pulsed light sources have been used, but there have been very few reports on the effectiveness of the potassium-titanyl phosphate (KTP) laser. We have extensive experience of this modality at our institution, and the purpose of this survey is to report on the safety and efficacy of the KTP laser. Using an in-house database, we retrospectively collected data from patients who had undergone treatment with the KTP laser for superficial vascular lesions. Patients of Fitzpatrick skin type I-IV were included. Exclusion criteria were Fitzpatrick skin type V, patients with obvious suntan and those on potentially phototoxic medications or minocycline therapy. Diagnoses included discrete or matted telangiectasia, strawberry naevus, spider angioma, rosaceal erythema, rosaceal telangiectasia, telangiectatic naevus, angioma, combined rosaceal erythema/telangiectasia, port-wine stain, venous lake haemangioma and hereditary haemorrhagic telangiectasia. Patients underwent an initial test treatment and further treatment at 6-week intervals as required. Clinical photographs were taken pre- and post-treatment, and outcome was graded by patient and physician. Adverse effects were recorded including scarring, hypo- or hyperpigmentation, marked swelling, blistering, scabbing and bruising. Six hundred forty-seven patients with 13 diagnoses on 9 different body sites were recorded. Four hundred eighty-six were female, and the median age was 39.5 years. Of the lesions treated, 33.7 % (n = 218) were discrete telangiectases and 31.8 % (n = 206) were spider angiomas. A 92.7 % of lesions were on the face. Four hundred thirteen (77.6 %) patients who had outcomes recorded at 6 weeks were graded as "clearance" or "marked improvement". Only 38 (5.8 %) patients experienced adverse effects, all of which were minor; the main adverse effect was swelling. Unlike the dye laser, there was only one case of bruising out of 647 patients. This is the largest survey of patients to have undergone KTP laser treatment reported in the literature. Our results show that the KTP laser is a safe and effective modality for the treatment of superficial vascular lesions.

Treatment of superficial cutaneous vascular lesions: experiencewith the KTP 532 nm laser

Clark C, Cameron H, Moseley H, Ferguson J, Ibbotson SH. Lasers Med Sci. 2004;19(1):1-5. Epub 2004 Apr 14.

ABSTRACT

Whilst most facial telangiectasias respond well to short-pulse-duration pulsed dye laser therapy, studies have shown that for the treatment of larger vessels these short-duration pulses are sub-optimal. Long-pulse frequency-doubled neodymium:YAG lasers have been introduced with pulse durations ranging from 1-50 ms and treatment beam diameters of up to 4 mm. We report the results of KTP/532 nm laser treatment for superficial vascular skin lesions. The aim was to determine the efficacy of the KTP/532 nm laser in the treatment of superficial cutaneous vascular lesions at a regional dermatology centre in a 2 year retrospective analysis. Patients were referred from general dermatology clinics to a purpose-built laser facility. A test dose was performed at the initial consultation and thereafter patients were reviewed and treated at 6 week intervals. Outcome was graded into five classifications by the patient and operator independently based on photographic records: clear, marked improvement, partial response, poor response, and no change or worsening. Over the 2 year period, 204 patients with 246 diagnoses were treated [156 female; median age 41 (range 1-74) years; Fitzpatrick skin types I-III]. Equal numbers of spider angioma (102) and facial telangiectasia (102) were treated. Of those patients who completed treatment and follow up, 57/58 (98%) of spider angiomas and 44/49 (90%) of facial telangiectasia markedly improved or cleared. Satisfactory treatment outcomes, with one clearance and two partial responses, occurred in three of five patients with port-wine stain. Few patients experienced adverse effects: two declined further treatment due to pain, and a small area of minimal superficial scarring developed in one case. Two patients developed mild persistent post-inflammatory hyperpigmentation, and one subject experienced an episode of acute facial erythema, swelling and blistering after one treatment. The KTP/532 nm frequency-doubled neodymium:YAG laser is a safe and effective treatment for common superficial cutaneous vascular lesions in patients with Fitzpatrick skin types I-III.

Comparison of the 532-nm KTP and 1064-nm Nd:YAG lasers for the treatment of cherry angiomas

Pancar GS, Aydin F, Senturk N, Bek Y, Canturk MT, Turanli AY. J Cosmet Laser Ther. 2011 Aug;13(4):138-41. doi: 10.3109/14764172.2011.594058. Epub 2011 Jun 20.

ABSTRACT

BACKGROUND: Laser therapy is the treatment of choice for cherry angiomas since it is more effective and has better cosmetic results. There is no comparative study about the treatment efficacies with KTP and Nd:YAG lasers for cherry angiomas.

OBJECTIVE: To compare the efficacy and side effects of 532-nm KTP and 1064-nm Nd:YAG lasers for the treatment of cherry angiomas.

METHODS: Two comparable lesions of the same patient were chosen. One of them was treated with the KTP laser while the other was treated with the Nd:YAG laser. Sessions were repeated every 4 weeks until complete clearance was achieved. Side effects were evaluated using a severity scale (0-4).

RESULTS: The number of sessions was significantly higher with the KTP than with the Nd:YAG laser ($p = 0.002$). Erythema, edema, pain and scar formation were higher in the Nd:YAG laser group (erythema: $p = 0.001$; edema: $p < 0.001$; pain: $p < 0.001$; scar: $p < 0.001$). The hyperpigmentation rate was statistically higher with the KTP laser ($p = 0.01$).

CONCLUSION: Both KTP and Nd:YAG lasers were found to be effective methods. The Nd:YAG laser offered fewer treatment sessions, but a higher risk of scar formation. The KTP laser seems more advantageous, but in dark-skinned patients the Nd:YAG laser may be preferable.

Acne rosacea: effectiveness of 532 nm laser on the cosmetic appearance of the skin

Maxwell EL, Ellis DA, Manis H. J Otolaryngol Head Neck Surg. 2010 Jun;39(3):292-6.

ABSTRACT

OBJECTIVE: The aim of the study was to perform a prospective blinded trial to compare the improvement of midface acne rosacea using 532 nm laser therapy with and without a retinaldehyde-based topical application.

SETTING: A private clinic and surgicentre specializing in facial plastic surgery.

DESIGN: A prospective randomized blinded clinical trial.

METHODS: Fourteen patients with type 1 erythematotelangiectatic acne rosacea were enrolled in the study. The side of the face to be treated was chosen randomly. The opposite side of the face served as the control. Patients underwent six treatments with the 532 nm laser, with four sets of photodocumentation over a period of 3 months. Following each treatment, patients were asked to rate their degree of improvement based on a 5-point improvement scale. A final assessment was performed by five separate blinded evaluators.

MAIN OUTCOME MEASURES: Final photographic evaluation to assess (1) reduction in overall redness, (2) reduction in visible telangiectasia, (3) difference between left and right sides of the face, and (4) degree of overall skin texture improvement.

RESULTS: Three men and eight women completed the study. Six right hemifaces and five left hemifaces were treated. One hundred percent of patients noted a mild to moderate improvement in all signs of type 1 acne rosacea, including overall redness of the face, telangiectasia, and skin texture. The blinded evaluators were able to note a difference between the treated and untreated sides 47% of the time.

CONCLUSION: The 532 nm laser combined with the topical retinaldehyde improved overall redness, telangiectasia, and skin texture in acne rosacea patients. The degree of improvement was greater when compared to using the laser alone as the sole treatment modality.

Treatment of spider leg veins with the KTP (532 nm) laser--a prospective study.

Spendel S, Prandl EC, Schintler MV, Siegl A, Wittgruber G, Hellbom B, Rappl T, Berghold A, Scharnagl E. Lasers Surg Med. 2002;31(3):194-201.

ABSTRACT

BACKGROUND AND OBJECTIVES: Spider leg veins are telangiectasias located intracutaneously. This condition poses a cosmetic problem.

STUDY DESIGN/PATIENTS AND METHODS: The purpose of this study was to determine what influence the KTP (532 nm) laser has on spider leg veins dependent on the vascular diameter and to what extent the skin has been affected. Seventy female patients were treated in three laser sessions. Analysis was done 30 weeks after the last laser treatment session.

RESULTS: Fifty-six patients completed the study. In group 1 (vascular diameter < or = 0.6 mm), spider leg veins were no longer visible in 33%; in 40%, a decrease in vascular diameter could be observed; in 27%, no change in size occurred. In group 2 (vascular diameter 0.7-1.0 mm), laser-treated spider leg veins were visible in all patients. Hyperpigmentation occurred in 13 patients.

CONCLUSIONS: The KTP (532 nm) laser is an effective for treating spider leg veins having a vascular diameter under 0.7 mm.

Diode laser for the treatment of telangiectasias following hemangioma involution.

Cerrati EW, O TM, Chung H, Waner M. Otolaryngol Head Neck Surg. 2015 Feb;152(2):239-43. doi: 10.1177/0194599814559192. Epub 2014 Dec 1.

ABSTRACT

OBJECTIVE:
Infantile hemangiomas are well known for their rapid growth during the first 6 to 9 months of life, followed by a spontaneous but slow involution. The standard of care is to treat these lesions at an early age with propranolol to expedite the involution process; however, surgery still remains an active component in the management. Medical treatment with propranolol or natural involution will often result in residual telangiectasias. We evaluated the efficacy of using a diode laser as a treatment for telangiectasias following cervicofacial infantile hemangioma involution.

STUDY DESIGN:
Case series with chart review.

SETTING:
Tertiary care hospital and practice specializing in the care of vascular anomalies.

SUBJECTS AND METHODS:
Twenty patients, aged 4 months to 11 years (average 2.69 years), underwent treatment with a 532-nm diode laser to treat the residual telangiectasias following hemangioma involution. All procedures were performed in the operating room. To assess the efficacy, we independently evaluated pre- and posttreatment digital photographs and ranked them on a 0- to 4-point scale (0 = no change and 4 = complete response). Adverse reactions were also recorded.

RESULTS:
The telangiectasias showed considerable improvement following treatment. In more than half of the patients treated, the affected area demonstrated a complete response. No adverse reactions were noted.

CONCLUSION:
A 532-nm diode laser effectively treats the remaining telangiectasias following hemangioma involution. Whether used independently or in conjunction with other treatment modalities, the diode laser should be part of the surgical armamentarium when treating infantile hemangiomas.

PIGMENTED LESIONS

(532 & 577 nm)

Efficacy of a new 577 nm high power optical pumped semiconductor laser (HOPSL) with scanning technology for the treatment of Melasma

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ABSTRACT

BACKGROUND Melasma is a common dermatologic condition. There are various therapeutic modalities for melasma but most of them have therapeutic limitations in the refractory melasma. Recently, several hypotheses have been suggested that increased vascularity is one of the major histologic findings in melasma and interactions between the cutaneous vasculature and melanocytes may play an important role in the development of melasma.

OBJECTIVE To evaluate the efficacy and safety of (577 nm) QuadroStarPRO YELLOW for treatment of melasma in Asians.

METHODS & MATERIALS Thirty-two volunteers with melasma were treated with the QuadroStarPRO YELLOW (577 nm), pulse duration 20-30 msec, fluences 8-14 J/cm^2, 80 % skin coverage for whole face. All subjects were treated monthly for four times and were followed up to 12 weeks after treatment completion. Efficacy was evaluated using objective and subjective ratings, Melanin index, modified Malasma Area and Melanin Index (mMAMI), modified Melasma Area and severity Index (mMASI). Patients evaluated pain scored using a visual analog scale during each treatment and evaluated satisfaction and MELASQOL at each follow-up visits. Physician and patient assessments were recorded at each visit and at a follow-up visit after the last treatment session.

RESULTS A statistically significant reduction in mMASI score was observed at every treatment and all follow-up visits and in MAMI score at 1-month post 3 to 4 laser treatments ($p < .01$) and 3-month follow-up visit after final treatment ($p < .01$). Adverse reactions included erythema and dryness on treated area.

CONCLUSIONS The QuadroStarPRO YELLOW (577 nm) is a safe, effective treatment for melasma. Long-term follow-up of cases are still required.

Introduction

Melasma is a common acquired pigmentary disorder of sun-exposed areas of the skin with significant psychological effect that is common in Asian women. The etiological factors are not fully understood, a possible pathogenesis are genetic influences, exposure to ultraviolet (UV) radiation, and sex hormones.[1]

Although there are many therapeutic options for melasma, including traditional therapies, including depigmenting agents (e.g., hydroquinone, azelaic acid), chemical peels (e.g., glycolic acid, b-hydroxyl acid, trichloroacetic acid), and sunscreens but most of them have therapeutic limitations in the treatment of refractory melasma.[2]

The use of lasers in the treatment of melasma is controversial. Ablative laser resurfacing (e.g. carbon dioxide laser and erbium-doped yttrium aluminum garnet laser have been reported successful, but they result in significant downtime, and there is a risk of adverse sequelae.[3] Treatment of facial melasma with light sources (Intense pulsed light)[4] and lasers such as Q-switched neodymium doped yttrium aluminum garnet (1,064 nm)[5], Q-switched alexandrite (755 nm) and fractional photothermolysis laser also have varying results, postinflammatory pigmentary changes, flares and recurrence of melasma.[6-9]

A major clinical characteristic of melasma is hyperpigmented patches, but additional characteristics in some types of melasma, pronounced telangiectatic erythema confined to melasma-lesional skin has been observed.[1] There are several hypotheses supporting angiogenetic factors that are related to some types of melasma.It has recently been suggested that increased vascularity is one of the major histologic findings in melasma and interactions between the cutaneous vasculature and melanocytes might have an influence on the development of pigmentation in the overlying epidermis and that the dermal environment may have an important role in the development of melasma.[10]

HOPSL 577 laser emit a yellow beam at a wavelength of 577 nm, which can be used to treat vascular lesions.[11] This study is a report of the clinical efficacy and safety after the use of QuadroStarPRO YELLOW, Asclepion Laser Technologies GmbH, Germany to treat melasma in Asian patients.

Patients and Methods

Thirty-two women with clinical diagnosis of melasma on the face were recruited to the study. Exclusion criteria included pregnant or nursing women, the use of a topical bleaching agent, hydroquinone, topical or systemic treatment with vitamin A analog including tretinoin within 2 months before the study, a history of chemical peeling or laser treatment on facial lesion within 6 months before the study, and the use of contraceptive pills at the time of the study or in the previous 6 months.

This clinical study was performed in accordance with the Declaration of Helsinki (1975) and was approved by the Ethical Committee on Research Involving Human Subjects, Institute of Dermatology, Thailand. We explained the procedures, risks, benefits, potential complications, and side effects of the procedure to all subjects, and written informed consent was obtained from each patient before commencement of this study. (Written informed consent was obtained from all study subjects.)

Before the treatments, the area was cleansed with a mild soap (L–soap, institute of dermatology). All subjects were treated with 577 nm QuadroStarPRO YELLOW with scanning technology, Asclepion Laser Technologies GmbH (Germany), pulse duration 20-30 msec, fluences 8-14 J/cm^2, 80 % skin coverage for whole face. To reduce the risk of PIH after treatments, the laser settings

were chosen according to the patient's skin type. Darker skin types were not treated beyond fluences 12 J/cm^2 with a longer pulse duration whereas lighter skin types were treated up to fluences 14 J/cm^2. All patients were treated at low energies initially, and if clinically indicated, energies were increased with subsequent treatments as tolerated. All subjects were treated monthly for a total number of four treatments. Identical laser technique was performed on each individual patient. Because the bigger the treatment area the higher the heat development and the higher the risk for unwanted side effects. The scanner is equipped with an integrated skin cooling that is suitable for treatment of large areas. A sufficient skin cooling may reduce side effects when treating with thermal operating technique. When the treatment of one area is finished a cooling pad is applied before continuing with the next area with the same technique. Additionally, cold air cooling device was used to cool the skin during laser irradiation at a cooling level of 2-4; 4-6 inches from the skin surface for all participants to minimize treatment discomfort. Lower settings were preferred because over cooling during treatment may increase inflammation at the dermal-epidermal junction, leading to greater PIH.[12] After each laser treatment, the degree of erythema, edema, and other post-treatment responses were recorded. Patients were asked to score pain immediately after treatment based on a visual analog scale of 0 (no pain) to 10 (worst pain). No postoperative analgesic treatment was required beyond the application of ice compresses. No prophylactic antibiotics or antiviral were given in any patient. Patients were counseled on the importance of sun avoidance, including the use of daily broad-spectrum sunscreen with ultraviolet A (UVA) and UVB protection (minimum sun protection factor 50) on the treated areas. Patients were informed of the tendency of melasma to return or worsen with sun exposure; thus, in addition to sunscreen, patients were advised to wear a broad-rimmed hat at all times when outside. Follow-up evaluations were made at 4-week intervals during the 12-week treatment period and at 4 weeks and 12 weeks after the final session (total study duration, 28 weeks from treatment commencement).

Outcome measures, the patients were evaluated on the Melanin index (MI) using a reflectance spectrophotometer (Mexameter MX18, Courage-Khazak, Koln, Germany) in order to obtain objective measurement of skin color at baseline and each follow-up visit. The three darkest areas of the involved skin in each cosmetic unit were measured and then calculated for mean MI and modified Melasma Area and Melanin Index (mMAMI) score. The patients were also evaluated skin color clinically using modified Melasma Area and Severity Index (mMASI) score.

The original MASI score determined by Kimbrough-Green and colleagues,[13] calculated by subjective assessment of 3 factors: area(A) of involvement, darkness(D), and homogenecity(H), with the forehead(f), right malar(rm), left malar(lm), and chin(c), corresponding to 30, 30, 30, and 10 % of the total face area, respectively. The area of involvement in each of these 4 areas is given a numeric value of 0 to 6, darkness and the homogeneity of hyperpigmentation are rate on a scale of 0 (minimal) to 4 (maximum), however, individual components of the MASI were problematic, homogeneity assessment by raters showed the least agreement and can be removed from MASI score without any loss of reliability or validity measures, therefore, we recommend removal of homogeneity from the MASI score. The modified MASI we propose is easy to learn and perform and is scored as follows: Modified MASI total score = [0.3 A(f) D(f)]+ [0.3 A(lm) D(lm)]+ [0.3 A(rm) D(rm)]+[0.1A(c) D(c)] The range of the total score is 0 to 24. Area and darkness are scored as follows: area of involvement: 0 = absent, 1 = <10 %, 2 = 10-29 %, 3 = 30-49 %, 4 = 50-69 %, 5 = 70-89 %, and 6 = 90-100 %; darkness: 0 = absent, 1 = slight, 2 = mild, 3 = marked, and 4 = severe.[14] A high mMASI score correlates with severe hyperpigmentation. For a more accurate quantification of the severity of melasma, the MAMI score was developed[15], using a MI instead of subjective evaluation for darkness and homogeneity of

melasma. The MAMI score counted the entire face, but our mMAMI score removal of homogeneity as in mMASI score. Therefore, mMAMI = (MI)(area).

Photographic documentation using Visia-CR (Canon EOS 5D Mark II, 21 Megapixel resolution, Lens Sigma 70mm, 30 sec + Bulb 1/8000 sec, F 16.0, Focal length 20.5 inch from the camera CCD, ISO 100, Xenon flash based lighting, Custom option mode) for baseline, before every laser visits and follow-up visits. In the efficacy analysis, two blinded, non-treating investigators who were not affiliated with this study assessed clinical improvement of treatment area using independent photographic review, using a modified Melasma Area and Severity Index (mMASI), as previously described. In addition, the patients were clinically evaluated using mMAMI and Safety evaluations were performed and any reported adverse effects and were recorded by treating physician. Patient satisfaction survey (1: 1-25 %, minimal to mild improvement; 2: 26-50 %, moderate improvement; 3: 51-75 %, marked improvement; and 4: >75 %, near total improvement) and MELASQOL scale[16] were also evaluated during the treatment series and in the follow-up visits

For statistical analysis, data obtained at each visit were compared with baseline data using the two-tails paired T-test. Data are expressed as means +/- standard deviation, and p< .05 was considered to be statistically significant.

Results

Thirty-two subjects with facial melasma (Fitzpatrick skin type III or IV) were enrolled in this study. Their average mean age was 45.6 ± 8.4 years. All patients continued with the study protocol.

Yellow laser-treated melasma lesions on the forehead showed a significant improvement in mean MI at last two follow-up visits after final treatment and the left cheek at 3-month follow-up visits after final treatment (p< .05, compare with baseline) but not significant on the chin and the right cheek.(figures 1). Mean mMASI scores decreased from 6.47 at baseline to 6.19, 5.65, 5.22, 4.76 and 4.38 at every treatment and all follow-up visit, respectively (p<0.01) and Mean mMAMI scores decreased from 723.62 at baseline to 644.12, 627.39 and 602.70 at 3rd treatment, 1- and 3-month follow-up visit after final treatment, respectively (p<0.05 pair) (figures 2 and 3).

Figures 4 demonstrate moderated improvement in melasma at 3-month follow-up after four treatments. The overall patients' satisfaction and scoring of improvement at 1-month follow-up after four treatments was 34.4 % marked improvement and 34.4 % near total improvement at the last follow-up visit as figures 5. mean MELASQOL score significantly decrease in every follow-up visits as figures 6 (p< .05). Most of the patients reported improvement of their melasma after three treatments. All patients note improvement of skin texture.

Intra- and postoperative discomfort was described as mild to moderate by most patients. At the time of treatment, patients reported mild to moderate pain (meanVAS 2.63 +/- 1.44). Mild post treatment erythema and edema was noted, which resolved within 24 hours. Some report of superficial crusting occurred and reepithelization was complete in 3-4 days in some patient. No additional adverse effects were observed, and no long-term complications were reported at the follow-up interviews.

Discussion

Melasma is a common dermatologic condition in dark-skinned women. Treatment of melasma is a challenge. Despite currently available various therapeutic modalities including topical bleaching creams, chemical peels, light and laser treatments, there still remains a subset of patients unresponsive to those therapies and have limited value.

Given the high incidence of postinflammatory hyperpigmentation and unpredictable efficacy, especially in patients with darker skin phototypes.

Recently, new insights into the pathogenesis of melasma have been suggested that histological characteristics at melasma lesional skin has pathologic dermal changes such as altered fibroblasts or greater vascularity.[10] Kim and colleagues[17] demonstrated that greater vascularity is one of the major findings in melasma and that VEGF may be a major angiogenic factor for altered vessels in melasma. VEGF is known to stimulate the release of arachidonic acid and the phosphorylation and activation of cytosolic phospholipase A2.[18] It is possible that the resulting metabolites from the arachidonic acid pathway affect melanogenesis. Human melanocytes may respond to angiogenic factors because normal human melanocytes express functional VEGF receptors.[19] Therefore, VEGF may have a direct influence on melanocyte behavior through its receptor.

Report the case of a woman with melasma of the forehead, previously enrolled in prior prospective split-face study comparing the use of stabilized Kligman's trio and combined with pulsed dye laser (PDL).[20] The purpose of using PDL (flat handpiece of 7 mm; pulse duration, 20 milliseconds; fluency, 10 J/cm^2; dynamic cooling device, 30/40) was to target the increased vascularization observed in the melasma lesions. Three years after the end of the treatment, she had a relapse of her melasma that completely spared the areas previously treated with PDL.

The perfect match between the present unaffected skin and the area previously treated with the PDL strongly suggests that the decrease of the vascular component with PDL treatment has prevented the recurrence of the melasma in this area. There is growing evidence indicating that melasma lesions have an increased vascularization.[21]

Hye In Lee, et al.[11] treat melasma in Asian patients by using copper bromide Plus/Yellow Laser The study results show that expression of VEGF in keratinocytes decreased slightly after treatment with 578-nm copper bromide yellow laser. The yellow laser would have some direct or indirect effects on melanogenesis through the effect on VEGF in keratinocytes, dermal angiogenesis, and inflammatory mediators, but in vitro and in vivo studies are needed for demonstrating a clear mechanism for the antiangiogenic and antimelanogenic effects of yellow laser.

This study data demonstrate the safety and efficacy of the Long pulsed Diode laser (577 nm) with scanning technology in the treatment of facial melasma in Asian women over 3 months of follow-up. Long pulsed Diode laser (577 nm) with scanning technology has been a newer addition to the treatment options available for melasma.

The yellow laser at 577 nm, and its pulse duration was calculated to match the thermal relaxation time of cutaneous blood vessels and its wavelength to coincide with the third absorption spectral peak of oxyhemoglobin, (578 nm β-peak), this treatment caused general coagulation with injury to papillary dermis that produces intravascular thrombus formation without epidermal damage and preservations of dermal appendages to a depth of 0.4-0.7 mm. Melanocytes express vascular endothelial growth factor (VEGF) receptors 1 and 2 and neuropilin. Thus, the VEGF and skin vascularization might play a role in the pigmentation processes and therefore in melasma.[22] With these modified laser parameters may decrease the melanocyte stimulation, by targeting the vascular component in melasma lesions, clearance of pigmentation of melasma with normalization in texture and color of the treated skin were seen.

MASI score been used to evaluate the result in melasma and correlated well with clinical response.[13,14] The MAMI score gave more accurate quantification of the melasma and was demonstrated to relate very well with the MASI score.[15] Because the mMASI score has been proven to be a more accurate measurement of melasma severity, in contrast to other studies using vascular

laser for melasma, mMASI and mMAMI score were used as the primary endpoint for our pilot study to assess improvement of melasma. We found that both scores correlated well with clinical response and were superior to photography in the evaluation of the treatment result. In addition, although MI in each cosmetic unit revealed an improvement after the first two sessions, MI on the right cheek deteriorated after the third session (12 weeks after commencement of the study) and plateaued in subsequent follow-ups, reflecting a slight recurrence of melasma over the follow-up period.

When treat melasma in darker skin types, it is necessary to be careful not to overtreat an area in order to reduce risk of post inflammatory hyperpigmentation, conservative lower setting were used to minimize inflammatory interruption of the epidermal–dermal junction, because it is thought that this may be responsible for the development of post inflammatory hyperpigmentation.[12] Patients in this study were treated with low energy settings initially (8-10 J/cm^2) that were increased with subsequent laser treatment visit. We found greater erythema and pain score when more aggressive settings were used. Erythema resolved in 24 hours, although it persisted longer when aggressive setting were used. Cooling is important when treating melasma, it can prevent the development of post inflammatory hyperpigmentation by preventing bulk heating. It is important not to overcool during treatment because this could lead to poorer efficacy.[12] There was no evidence of scarring, erosions, or post-inflammatory hypo- or hyperpigmentation throughout the course of this study. Although no long-term complications, few superficial crusting occurred and reepithelialization was complete in 3-4 days in few patients at some visit of treatment. That may due to false adjustments of the fluence and the pulse duration and therefore can lead to overtreatment. Patients also reported occasional pruritus that may the result from dryness of the skin after treatment.

Melasma can have significant emotional and psychological effects on those affected with the condition. The MELASQOL can be used to monitor the level of impairment individuals suffer due to their melasma.[16] Interestingly, only moderately correlated with mMASI and mMAMI. This supports the idea that patients often view the impact melasma has on their lives based on criteria other than disease severity. The MELASQOL can therefore be utilized to assess better the psychosocial aspect of melasma.

In summary, this study demonstrates that QuadroStarPRO YELLOW (577 nm) with scanning technology is a new treatment modality for melasma that is a safe and temporary effective treatment modality for melasma. We suggest that this vascular laser may be a treatment option for melasma specially accompanied by pronounced telangiectasia. However, maintenance and conjunctive therapy with chemical peels or topical bleaching preparations as well as application of a broad spectrum sunscreen may be necessary to maintain the improvement.

Although this study assessed subjects through the 3-month time point, controlled studies longer with a follow-up period are warranted to fully evaluate about the prevention of relapses and to determine the optimal parameters and schedule of this treatment modality. Future studies using a randomized, split-face design comparing the QuadroStarPRO YELLOW with other specific lasers, in addition to studies comparing the QuadroStarPRO YELLOW with traditional bleaching creams, would further define the role of vascular laser in the treatment of melasma.

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Efficacy of 577 nm pro-yellow laser in the treatment of melasma: a prospective split-face study

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ABSTRACT

We aimed to study the effectiveness of 577 nm pro-yellow laser in the treatment of melasma. A total of 82 patients with melasma were included in this comparative study. A detailed medical history, examination, and calculation of Melasma Area and Severity Index were done for all patients. All participants were treated with topical sunscreen and hydroquinone 4% cream on both sides of the face. In addition, the left side of the face was subjected to a single pass of 577-nm pro-yellow laser at a monthly interval for three sessions. Follow up was done by comparing the Melasma area and severity index at 0, 3 and 6 months. At baseline, there is no significant difference in the Melasma area and severity index score between both sides of the face. At 3 months, MASI score was statistically significantly decreased on both sides of the face compared to pretreatment ($P < .05$). At 6 months, the mean MASI score at the laser-treated side was statistically significantly decreased compared to the non-laser-treated side ($P < .05$). we concluded that the addition of 577 nm pro-yellow laser in the treatment of melasma leads to maintain the improvement and reduction of the recurrence rate.

Introduction

Melasma is a common acquired condition of symmetric hyperpigmentation, typically occurring on the face (1). Melasma appears as irregular macules and patches ranging from light-to dark-brown commonly seen in darker-skinned women (2).

The pathogenesis of melasma is not yet fully understood, stimulation of melanocytes by ultraviolet light exposure is the most accepted theory. Genetics, hormones, and photosensitizing medications may contribute to UV sensitivity (3).

Another theory suggests that increased vascularity is one of the major findings in melasma. Human melanocytes may respond to angiogenic factors because normal human melanocytes express functional vascular endothelial growth factor receptors (4).

Many treatment options for melasma as broad-spectrum photoprotection, topical compounds, Chemical peels and laser therapies (5). Hydroquinone is the gold standard for the treatment of melasma commonly used at concentrations of 2–4%. It is effective in treating melasma through suppression of melanin synthesis through inhibiting the sulfhydryl groups and acting as a substrate for the tyrosinase. Additionally, generation of reactive oxygen species and quinones can result in the oxidative damage of tyrosinase (6).

Laser devices are often employed to treat pigmentary disorders through their photothermal, photomechanical, and ablative effects. The pro-yellow laser, at 577 nm, has an ideal wavelength for treating cutaneous vascular disorders. This laser can target both the vascular and pigmented components of melasma (7).

Patients and methods

This is a prospective study carried out after being approved by The local Ethics Committee. This study was performed at the Dermatology department of Al-Azhar University Hospital, Assiut, Egypt, during

the period from October 2015 to April 2018. All Patients were informed about the study procedures, risks, benefits, potential complications, and side effects. Participants who accept the study protocol were included in the study after signing an informed consent form.
Participants in this study (n = 82) patients with melasma, aged more than 16 years, with Fitzpatrick skin phototypes ranging from Type III to Type IV, were recruited. The exclusion criteria were pregnant or nursing women, patients with a history of active facial bacterial, viral or fungal infections, history of poor wound healing or keloid formation, photosensitivity, previous esthetic surgery in the last 6 months, systemic diseases and systemic steroids or isotretinoin therapy in the last year, and immuno-compromising diseases.
A detailed history of age, sex, duration of melasma, family history, previous treatment, triggering factors of melasma, residence, and occupation was taken. A dermatologic examination was performed to clinically classify the type of melasma into centrofacial, malar, or mandibular patterns, and Wood light examination was performed for the determination of the type of melasma (epidermal, dermal, or mixed).
All patients were treated with topical sunscreen with SPF more than 50 and hydroquinone 4% cream (Meloquine 4% cream, Biopharm company, Egypt) on both sides of the face and the left side of the face was treated monthly with a single pass of 577-nm pro-yellow laser (QuadroStar PRO YELLOW® Asclepion Laser Technologies, Germany). Parameters used: scanner mode, initial fluence was 14 J/cm2 and increased by 2 J/cm2 every session and 80% coverage for 3 sessions.
Prior to the procedure, patients were instructed to avoid sun exposure during and after the treatment and to regular use a broad-spectrum sunscreen. On the day of treatment, patients were advised to wash thoroughly with soap and water and not to put any makeup. During treatment, the patient and physician wear specific goggles to guard against harmful effects of laser on eyes. Saline-moistened gauze was used under opaque patient goggles to ensure that the patient's eyes remain closed during treatment.
Postoperative care included a moisturizer applied in circular motions can aid in decreasing the sunburn-like sensations and avoid exposure to sun 2 weeks after treatment. No harsh soaps, scrubs, glycolic or retinoic acid-containing products or manipulation of the treated areas are permitted. In addition, the Patients were advised to use sunscreen regularly.
Melasma area and severity index (MASI) score for both sides was calculated at 0, 3 and 6 months follow up according to the method described by Kimbrough-Green et al. (8). Digital photographs of the lesions were taken before and after every session to assess any changes in the clinical appearance and to evaluate the response to treatment. All photographs were taken with an Olympusc-420 digital SLR camera 10 megapixels, using identical camera settings, lighting, and patient positioning.

Statistical evaluation

The data were analyzed using SPSS program (SPSS Inc., Chicago, IL) Version 22.0. Mean ± standard deviation (SD) was used for quantitative data and number (n) and percentage (%) for qualitative data. The following tests were used for the analysis of the results: paired sample t-test, and analysis of variance. Relationships between values were studied by Spearman correlation test. A *p*-value <0.05 was considered statistically significant.

Results

The final study cohort was made up of 82 patients (4 males and 78 females) with melasma, with a mean age of the patients was 34.22 (range16–51 years) and the mean duration of melasma was

6.48 ± 4.93 years (range 1–25 years). Based on Fitzpatrick skin type, patients were classified into: 48 (58.5%) patients were grade III and 34 (41.5%) patients were grade IV. Family history was positive in 40 (48.8%) patients and negative in 42 (51.2) patients. By Wood's light examination, 64 (78%) patients had an epidermal melasma, 15 (18.3%) patients had a dermal-type and 3 (3.7%) patients had a mixed-type (Table 1).

Table 1. Clinical characteristics of studied population.

Age/year Mean ± SD (Range)	34.22 ± 6.69 (16–51)
Duration of melasma/years Mean ± SD (Range)	6.48 ± 4.93(1–25)
Female	78 (95.1%)
Female	4 (4.9%)
III	48 (58.5%)
IV	34 (41.5%)
Positive family history	40 (48.8%)
Site of melasma	
Centrofacial	39 (48%)
Malar	38 (46%)
Mandibular	5 (6%)
Type of melasma	
Epidermal	64 (78%)
Dermal	15 (18%)
Mixed	3 (4%)

At baseline, there is no significant difference in MASI score between the two sides of the face. At 3 months, compared to baseline; MASI score was statistically significantly decreased on both sides of the face ($P < .05$), but there is no significant difference between laser-treated side and non-laser-treated site ($P \geq 0.05$). After 6 months, the mean MASI score at the laser-treated side (left side of the face) was statistically significantly decreased than non-laser-treated side (right side) ($P < .05$) (Table 2, Figure 1).

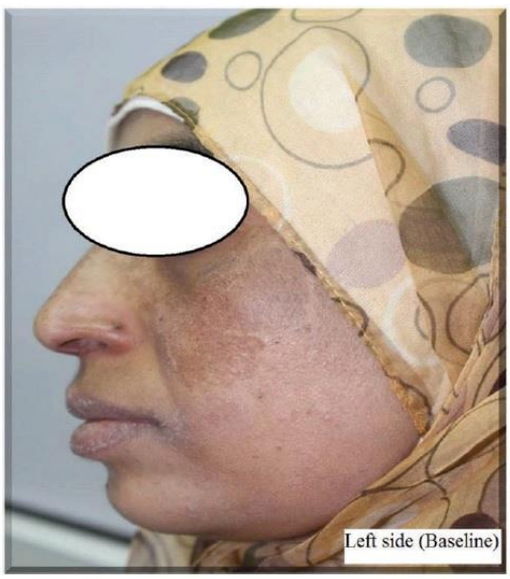
Table 2. Mean ± SD MASI score of melasma at right and left sides of the face at 0, 4 and 6 months after treatment.

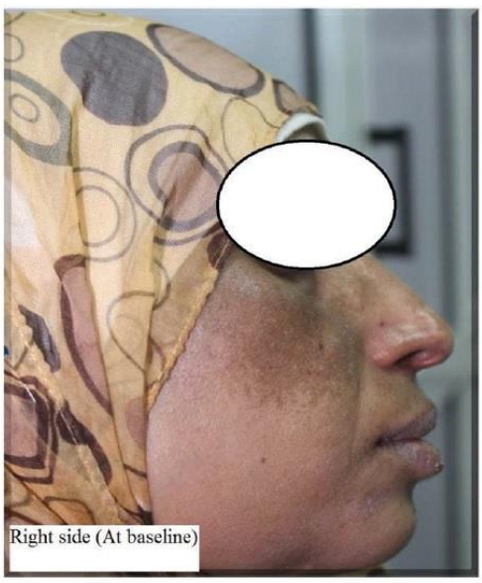
	Right side	Left side	P value
At baseline	7.31 ± 4.76	7.26 ± 4.76	.49
After 3 months	0.7 ± 1.35	0.7 ± 1.35	.34
After 6 months	2.54 ± 2.45	1.16 ± 1.8	.001*

***Significant $p < .05$**

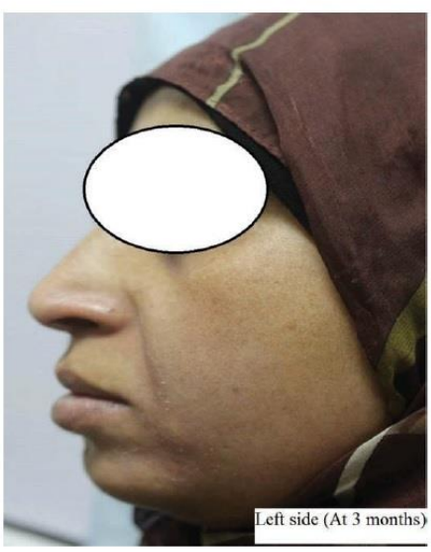
Figure 1. Significant improvement of melasma 3 months after both treatments. After 6 months follow up, recurrence was significantly higher in only hydroquinone treated side compared to hydroquinone and laser-treated side.

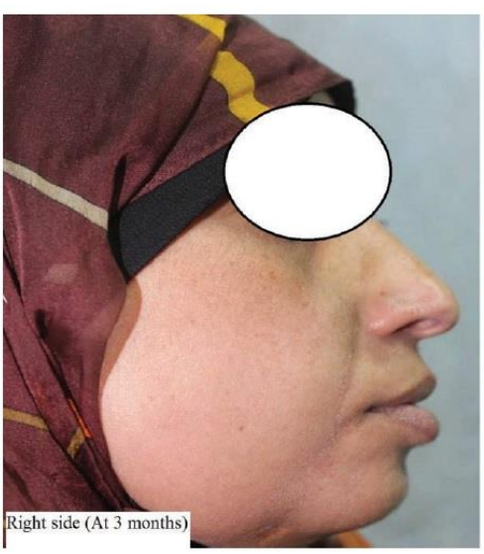
a


Left side (Baseline)


Right side (At baseline)

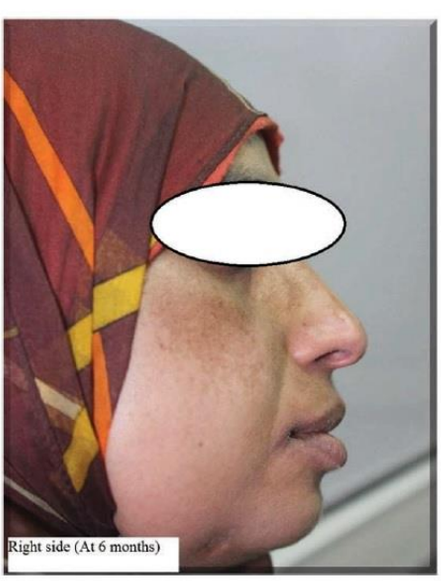
b


Left side (At 3 months)


Right side (At 3 months)

c


Left side (At 6 months)


Right side (At 6 months)

There was no significant relation between improvement of melasma and patient ages, sex, Skin photo-type, family history, and duration or site of melasma, while; there was significant relation between improvement and type of melasma (Table 3). Side effects reported in this study were hyperpigmentation in 2 (2.4%) and transient erythema in 5 (6.1%) patients.

Table 3. Correlation coefficient between percentage of improvement and clinical parameters.

	Percentage of improvement	
	t- test	p value
Age	1.2	.2
Sex	–0.1	.9
Skin phototype	0.4	.7
Family history	1.1	.3
Duration of melasma	0.4	.7
Site of melesma	–0.3	.8
Type of melesma	1.2	.003

Discussion

There is growing evidence indicating that melasma lesions have an increased vascularization (4,9–11). However, the role of this vascular component in the pathogenesis of melasma is still controversial. In some types of melasma, pronounced telangiectasia in lesional skin has been observed and topical tranexamic acid (plasmin inhibitor) is an effective therapeutic option in the treatment of melasma (4,12).

Vascular lasers may serve as an effective therapeutic option in the treatment of melasma especially in resistant cases (13). Galeckas et al. (14) reported that pulsed dye laser and intense pulsed light were highly effective in the photorejuvenation of vascular and pigmented facial dyschromias. Hassan et al. (15) reported that both PDL and IPL were effective and safe treatment modalities for lightening of melasma. VEGF can be proved as a possible mechanism underlying the action of both PDL and IPL on melasma.

The aim of this study was to study the effectiveness of 577 nm pro-yellow laser in the treatment of melasma.

In the current study, after treatment; there is an equally significant improvement of melasma in both sides of the face (Hydroquinone treated site and hydroquinone plus pro yellow laser-treated side). After 6 months follow up, the mean MASI score was significantly decreased in the laser-treated side compared to non – laser-treated side which indicates that blood vessels have a possible role in the pathogenesis of melasma and vascular laser may serve an important therapeutic modality in maintaining the improvement of melasma.

The efficacy of hydroquinin has been proved as an effective therapeutic modality for the treatment of melasma (16,17), while, after reviewing the published data through a detailed PubMed search, we did not find any research on the use of the pro-yellow laser for the treatment of melasma. The copper bromide and pulsed dye lasers were the closest vascular laser device used in the treatment of melasma.

Lee et al. (11) studied the effect of copper bromide laser in the treatment of melasma in 10 Korean women with melasma. They reported that a significant decrease in the mean MASI score after treatment, while; the expression of VEGF in keratinocytes decreased slightly. They concluded that the yellow laser may be a treatment option for melasma especially accompanied by pronounced telangiectasia.
However, another study by Hammami Ghorbel et al. (18) reported that Kligman formula combination cream is more effective than the copper bromide laser for treating melasma and recurrence occurred after both treatments. Also, they demonstrated that there is no difference in vascularization between both groups suggests that the copper bromide laser did not effectively target the vascular component of melasma. Also,; Eimpunth et al. (19) showed that the Copper Bromide Laser is not effective in improving melasma in dark-skinned phototypes patients.
Matched with our results, a split-face study on the effect of pulsed-dye laser with Kligman formula cream versus Kligman formula cream alone showed a benefit of the laser-plus-cream treatment of melasma (20). After 3 years follow up, relapse occurs in one patient spared the area previously treated with PDL, which suggests that targeting the underlying vasculature may prevent recurrence (21).
Although the efficacy of vascular-targeted laser in the treatment of melasma may be affected by intensity of sun exposure, skin phototype, and treatment techniques (19). Our study showed that there is no significant correlation between improvement of melasma after treatment and patient ages, duration of melasma, sex, skin photo-type, family history or of melasma, while there is a significant positive relation between improvement and type of melasma.
We concluded from this study that the addition of pro yellow 577-nm diode laser in the treatment of the melasma can contribute to the maintenance of improvement and delay the recurrence rate.

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Split treatment of photodamaged skin with KTP 532 nm laser with 10 mm handpiece versus IPL: a cheek-to-cheek comparison.

Butler EG 2nd, McClellan SD, Ross EV. Lasers Surg Med. 2006 Feb;38(2):124-8.

ABSTRACT

BACKGROUND AND OBJECTIVES: The treatment of photodamaged skin with potassium-titanyl-phosphate (KTP) laser and intense pulsed light (IPL) has been reported in several studies. Each device has strengths and weaknesses; however, patient and device variability have made it difficult to ascertain the optimal device for photorejuvenation. The objective of this study was to obtain a head-to-head comparison of IPL and KTP laser for photorejuvenation. Each patient received one KTP laser treatment on one side of the face and one IPL treatment on the other side.

STUDY DESIGN/MATERIALS AND METHODS: Seventeen patients with skin types I-IV were accepted into the study based on existence of dyschromias (pigmented and vascular) and/or discrete telangiectases. After performance of test spots on each patient to determine optimal settings for both devices, patients were treated with both devices in a split face manner. Evaluations and photographs were performed 1 week and 1 month after treatment. Patient and observer evaluations of results were recorded, as well as time to perform each treatment, and patient feedback with regard to pain and edema. No anesthesia was used in these treatments. Photographs were reviewed by a panel of blinded observers to assess changes in red and brown dyschromias.

RESULTS: One month average improvement (evaluator) for IPL side was (mean) 38.16%/35.08% for vascular/pigment lesions versus 41.99%/30.21% for KTP side. Patient self-evaluated global improvement at 1 month was (mean) 65.59% for IPL side versus 60.88% for KTP side. A majority of patients found the KTP to be slightly more painful with a mean pain rating of 5.27 of 10 versus 4.4 of 10 for IPL. A majority of patients experienced subjectively greater post-procedure swelling on the KTP side. Time to conduct treatment was an average of 10.0 minutes for IPL, 8.7 minutes for KTP.

CONCLUSIONS: Both large spot KTP and IPL achieved marked improvement in vascular and pigmented lesions in one session. The KTP laser caused slightly more discomfort and edema than the IPL. On the other hand, the KTP laser was faster, and more ergonomically flexible.

OTHER LESIONS

(532 & 577 nm)

An alternative for the treatment of vulvar syringoma: 577 nm pro-yellow laser

Gulhan Aksoy Sarac, Meltem Onder. J Cosmet Dermatol. 2021 Apr 27. doi: 10.1111/jocd.14186.

Abstract

Background: Syringoma is a benign sweat gland tumor.

Aim: Vulvar location of syringoma is rare. Although the lesions are asymptomatic, it requires treatment due to the cosmetic concerns.

Patients/methods: We present a 42-year-old woman with vulvar syringoma.

Results: The patient treated with 577 nm pro-yellow laser with a great success.

Conclusion: A 577 nm pro-yellow laser is a good alternative in the treatment of vulvar syringoma.

1 | INTRODUCTION

Syringoma that characterized by skin-colored 1–5 mm in diameter papules is a benign sweat gland tumor.[1] It predominantly appears in females during puberty and the lesions are frequently located in eyelids, malar regions, neck, and chest.[2] Vulvar syringoma is an extremely rare condition that was firstly described by Carneiro et al in 1971.[3] Although most of the vulvar syringomas asymptomatic, it may rarely present with vulvar pruritus.[4] There are various treatment choices for the management of vulvar syringomas including topical tretinoin, chemical peelings, electrodessication, laser therapy, and surgical excision.[5] Here, we present a case with vulvar syringoma that was treated by 577 nm pro-yellow laser.

2 | CASE REPORT

A 42-year-old woman was admitted to our dermatology clinic with a history of multiple skin-colored slightly elevated tumors located on vulva and vulvar itching. The lesions have been present since the age of 18 and number of the lesions increased over the years. Vulvar pruritus was intermittent and there was no change in symptoms during menstruation. On physical examination; multiple, soft, skin-colored, 2–5 mm-diameter papules were seen on the vulva.

No similar lesions were present elsewhere. A biopsy of the lesion was performed. Histopathological examination revealed numerous small ducts lined by a double layer of epithelial cells embedded in a fibrous stroma. Some of the ducts contained amorphous debris in the lumina. The diagnosis of vulvar syringoma was made on the basis of these clinical and histopathological findings. The lesions were treated with 577 nm pro-yellow laser after the application of local anesthesia. We used continuous wave mode and only two sessions were applied with 4 weeks intervals. After the procedure, the patient was recommended to use antibiotic cream that contains fusidic acid. After 4 weeks of follow-up, the lesions almost completely disappeared with no complaints of pruritus (Figures 1 and 2).

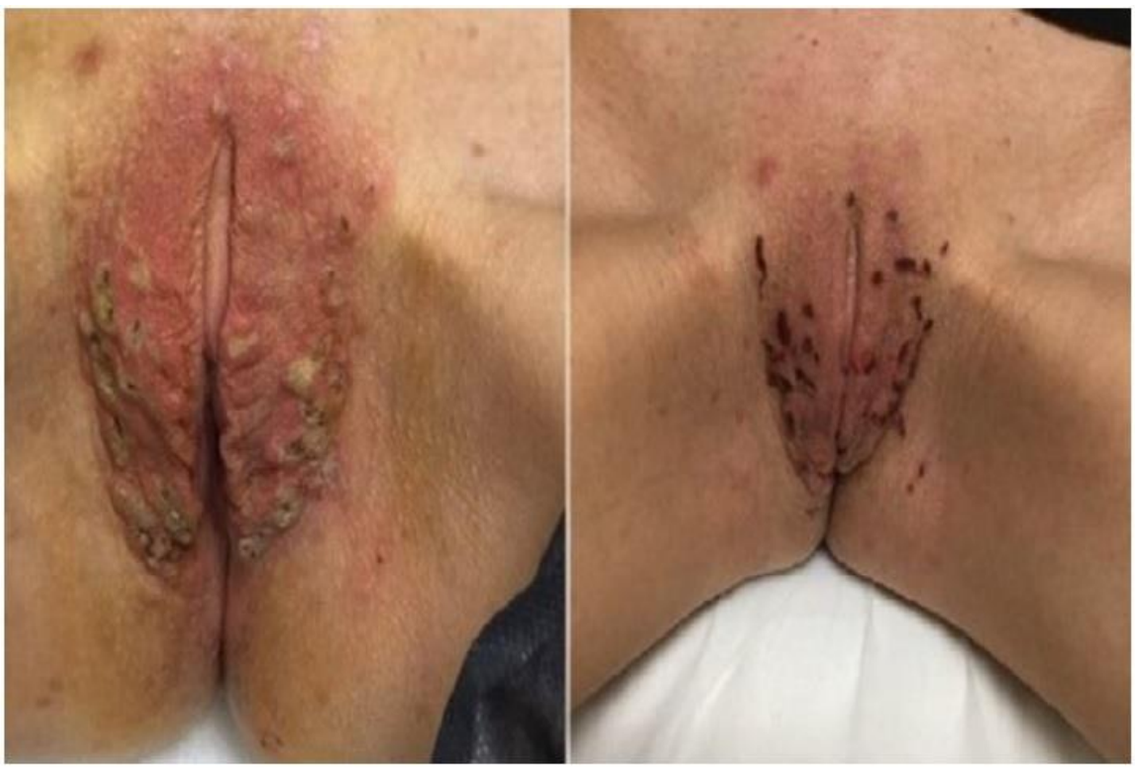

FIGURE1 Vulvar syringoma after the first session of pro-yellow laser (A) and 1 week after the session (B)

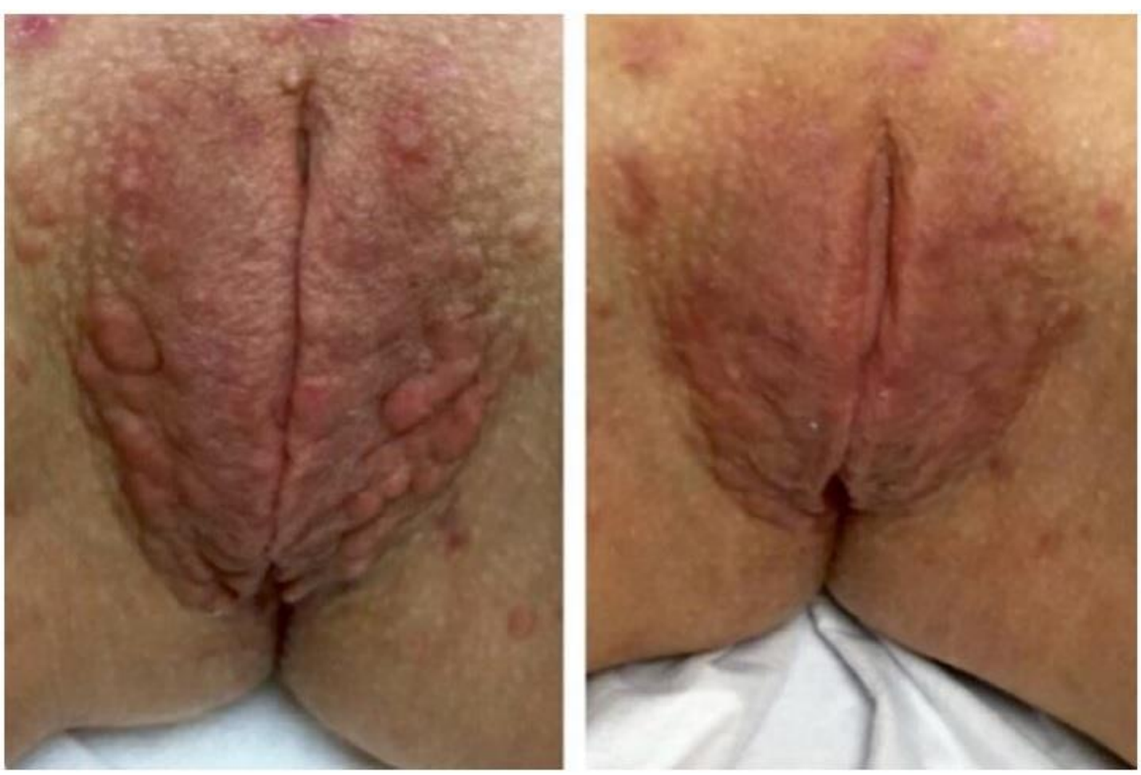

FIGURE2 Vulvar syringoma before the treatment (A) and 4 weeks after the second session of pro-yellow laser (B)

3 | DISCUSSION

Syringoma is a benign tumor of the eccrine sweat glands that presented with multiple skin-colored tiny papules located on eyelids, cheeks, neck, chest, and rarely on vulva[2]. The lesions are usually asymptomatic but in vulvar syringoma pruritus and discomfort may be experienced during menstruation, pregnancy, and summer months.[6] Vulvar syringomas can be presented in three different clinical forms. These are multiple skin-colored or brownish papules with symmetrical involvement of the labia majora, cystic lesions, or lichenoid plaques.[6,7] Lichen planus, Fox-Fordyce disease, lichen simplex chronicus, steatocystoma multiplex, anogenital wart, and epidermal cysts should be considered in differential diagnosis.[4,8,9]

No treatment is required in syringomas except for cosmetic concerns. There are various treatment choices such as topical tretinoin, topical atropine, cryotherapy, electrodessication, chemical peeling, surgical excision, and laser therapy.[5,10,11]

The lasers that have been used in removal of syringomas are carbon dioxide, argon, and erbium-YAG laser.[5]

The lesions can be removed by carbon dioxide laser easily but may lead to complications including hyperpigmentation, scarring, and delayed wound healing.[5] Also argon laser with a 514 nm wavelength can be applied for the treatment of syringomas, blister formation can be seen after therapy.[1]

The 577 nm pro-yellow laser is a yellow light that has been used in the treatment of diabetic retinopathy for 20 years.[12] It has been used in dermatological fields for 4 years, usually in the treatment of vascular skin lesions like telangiectasia,[13] port-wine stain,[14] and post-acne erythema.[15]

Its use in the treatment of vulvar syringoma has not been reported previously. Here, we applied two sessions of 577 nm pro-yellow laser to the vulvar lesions in continuous wave mode with a 1,5 mm spot size and 2 W power with 4 weeks intervals. Wound care with topical antibiotic cream including fusidic acid accompanied. Four weeks after the sessions, the lesions disappeared and no symptoms of itching were reported.

Pro-yellow laser can be used as an ablative laser in “continue wave” mode. It prevents bleeding during ablation due to its good vision of vascular structures and oxyhemoglobin and also it reduces recurrence by decreasing the vascular circulation in the residual tissue. Other deep ablative procedures require long downtime. Our patient had experienced mild erythema and edema, the lesions healed in 7 days.

As a conclusion, a 577 nm pro-yellow laser is a reliable, easy, and effective alternative to treat vulvar syringoma. Further studies are necessary to evaluate long-term outcome and the effect on syringomas of other regions.

CONFLICT OF INTEREST

No conflict of interest.

DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available from the corresponding author upon reasonable request.

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Treatment of recalcitrant viral warts using a 577-nm wavelength high-power optically pumped semiconductor laser

Bianca Bigge / Stefan Bigge Photonics & Lasers in Medicine. Band 5, Heft 3, Seiten 219–223, ISSN (Online) 2193-0643, ISSN (Print) 2193-0635, DOI: 10.1515/plm-2016-0013, July 2016

ABSTRACT

We report the use of a 577-nm wavelength high-power optically pumped semiconductor laser (HOPSL) to treat 12 patients with multiple recalcitrant non-genital warts that had not responded to conservative and invasive treatment. The patients were treated weekly using a 577 nm HOPSL connected to a scanner device. Ten patients with warts showed complete clearance after treatment. One patient had partial clearance and one did not respond at all. Slight to medium pain (visual analog scale, VAS=2–6) was reported during treatment. After treatment there was no evidence of scarring. After the 6-month follow-up there was no recurrence of the completely cleared warts.

1 Introduction

Normally viral infections of the skin are self-limiting [1]. However, despite this self-limitation it is not possible to predict the endurance of infection. Although various therapies are available [2–4], there is no therapeutic option that offers guaranteed clearance and often therapy is associated with a long down time and/or much pain. The carbon dioxide (CO2) laser [5, 6] and the erbium: yttrium aluminum garnet (Er:YAG) laser [7] ablates the tissue but this modality is also often associated with scarring. Moreover, the plume and gas produced during the ablation is infectious and must be evacuated. Potassium titanyl phosphate (KTP) lasers, either non-consumables requiring 532-nm KTP lasers [8] or consumable-based KTP pumped dye lasers requiring a dye cartridge when using 585 nm wavelength, are also an established option for therapy but need a scanner to achieve reproducible results. The pulsed dye laser (PDL) [9–11] clears the warts by selective photothermolysis of the blood vessels supplying the wart with nutrients. Treatment with the PDL is actually the favored therapy in the treatment of viral warts. But the resulting costs for the dye kit make the treatment very expensive. Use of the long-pulsed neodymium:YAG (Nd:YAG) laser is also a proven therapy [9, 12].
We report on the use of a 577-nm high-power optically pumped semiconductor laser (HOPSL) with a scanner device for the treatment of 12 patients with multiple recalcitrant non-genital warts that had failed to respond to with liquid nitrogen and/or topical treatments such as keratolysis combined with 5-fluorouracil (5-FU).

2 Subjects and methods

2.1 Patient group

Twelve patients (eight female and four male) took part in this study (Table 1). The patient age ranged from 4 to 37 years, with a median of 12 years. Nine patients were aged 14 years or younger. All patients had warts that had proved resistant to conservative and invasive therapy with a persistence of 12 months or longer. They had failed to respond to therapy with keratolysis, keratolysis combined

with 5-FU, cryotherapy with liquid nitrogen, keratolysis with curettage, wIRA® irradiation which uses water-filtered infrared light, or erbium:YAG, long pulsed Nd:YAG and CO_2 laser treatment. All patients had multiple warts on either their hands or feet or both, and two patients had periungual warts.
All patients and their parents were informed about the experimental nature of the therapy. All consented in written form and had sufficient time for consideration. Treatments were undertaken in accordance with ethical principles.

Table 1: Treated patients.

Patient no.	Age	Gender	Localization	Previous treatments
1	4	F	Hands, feet	Cryo
2	5	F	Hands, feet	Cryo, curettage
3	7	F	Hands, feet	Cryo, curettage
4	7	M	Feet	Curettage, CO_2 laser
5	12	M	Hands, feet	5-FU, curettage, cryo
6	12	F	Hands	5-FU, curettage, Er:YAG laser
7[a]	12	F	Feet	Curettage, CO_2 laser
8	13	F	Feet	Curettage, Er:YAG laser
9	14	M	Hands	5-FU, curettage, wIRA®
10	16	M	Feet	5-FU, curettage, cryo
11	32	F	Feet	Cryo
12[b]	37	F	Feet	Cryo, CO_2 laser, Nd:YAG laser

F, Female; M, male; 5-FU, 5-fluorouracil; wIRA®, irradiation which uses water-filtered infrared light.

[a]In patient no. 7 the warts did not clear at all. [b]In patient no. 12 the warts only cleared partially.

2.2 Treatment protocol

Initially all patients were treated weekly, and after the first two sessions, every 2nd week, with a 577-nm HOPSL (QuadroStarPROYELLOW; Asclepion Laser Technologies GmbH, Jena, Germany) connected to a cooled scanner device. The spot size was 1 mm, the size of the scanner pattern was 15 × 15 mm at 100% density with 36-ms pulses and a radiant exposure of 16–22 J/cm^2 for each pass (Figure 1). Before laser treatment, each wart underwent curettage after keratolysis with Guttaplast® plaster (Beiersdorf AG, Hamburg, Germany) that has been removed before curettage. After curettage each wart was treated immediately with the laser. The whole treatment included three passes in one session with a waiting time of 3 s, before and after each scan allowing the cold scanner in skin contact to cool down the treatment area for better pain control. Throughout the whole treatment no bleeding was observed. The scanner pattern was large enough to extend about 0.5 cm over the borders of the wart. If the wart was too big to fit within the scanner pattern, the scanner was repositioned to overlap the treated area at the borders.

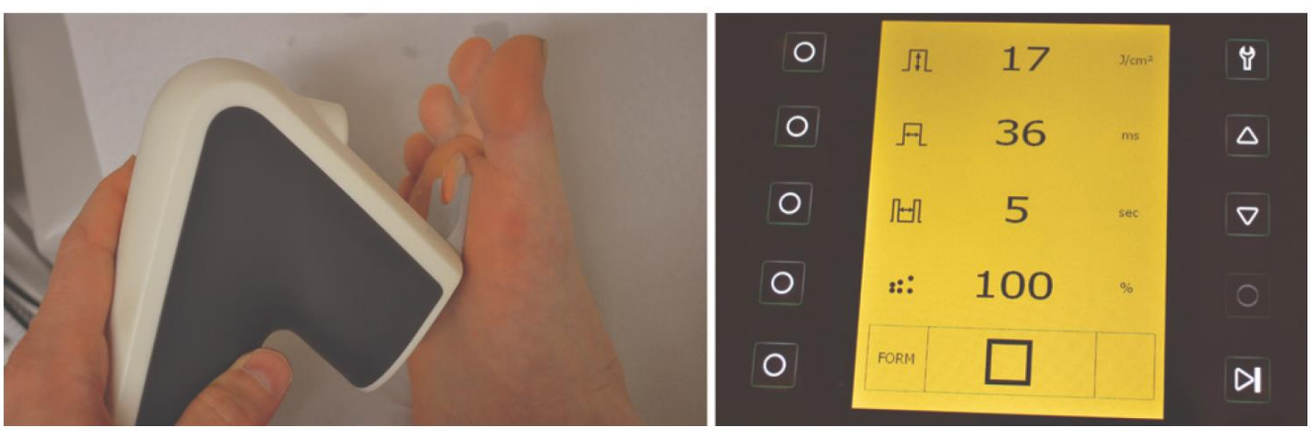

Figure 1: Laser set-up (left) and chosen laser parameters (right).

Emla® cream, an anesthetic cream, was used in two cases where the cooling of the scanner device was insufficient, but the pain control remained not sufficient (visual analog scale, VAS = 6). Therefore later on, cold air was applied parallel to the treatment with a skin cooling system (Cryo 6; Zimmer Medizin Systeme GmbH, Neu-Ulm, Germany). Patients reported better pain control (VAS = 3–4) with the added cold air. Multiple sessions were necessary for all the patients. There was a 1-week interval between the first two sessions. After the 2nd treatment a rest interval of 2 weeks was implemented. The patients were instructed how to peel the hyperkeratotic areas between treatments and how to disinfect their homes, all their shoes and clothing. No other wart treatment was allowed between the weekly sessions. The main criterion to end the treatment was that no wart was dermoscopically visible (handyscope; FotoFinder Systems GmbH, Bad Birnbach, Germany).

2.3 Assessment

Each patient was reviewed by the same clinician. They were interviewed about any adverse effects, about pain after treatment and about any change in the warts. Progress was documented on a chart which depicted feet and hands and successfully treated warts were marked off after dermatoscopic control. The success of the treatment was graded into: complete clearance, partial clearance and no

change/progress. Complete clearance meant a recovery of the normal skin at all sites of previous infected areas. Partial clearance was defined as recovery of normal skin at more than 50% of the infected area. All others were rated in the “no change/progress” group. All patients were asked about the pain during treatment and asked to evaluate the pain level using a 1–10 visual analog scale (VAS).

3 Results

Ten patients showed complete improvement with treatment (Figures 2 and 3). The warts disappeared completely after 3–12 sessions of treatment. Only two out of 12 patients showed partial or no improvement and did not wish to continue the treatment (Table 2). It was suggested to one of those patients that she should stop the treatment because of a lack of improvement after four treatments. However, the patient wanted to continue, hoping that there would be some improvement. After the 6th appointment the treatment was stopped.

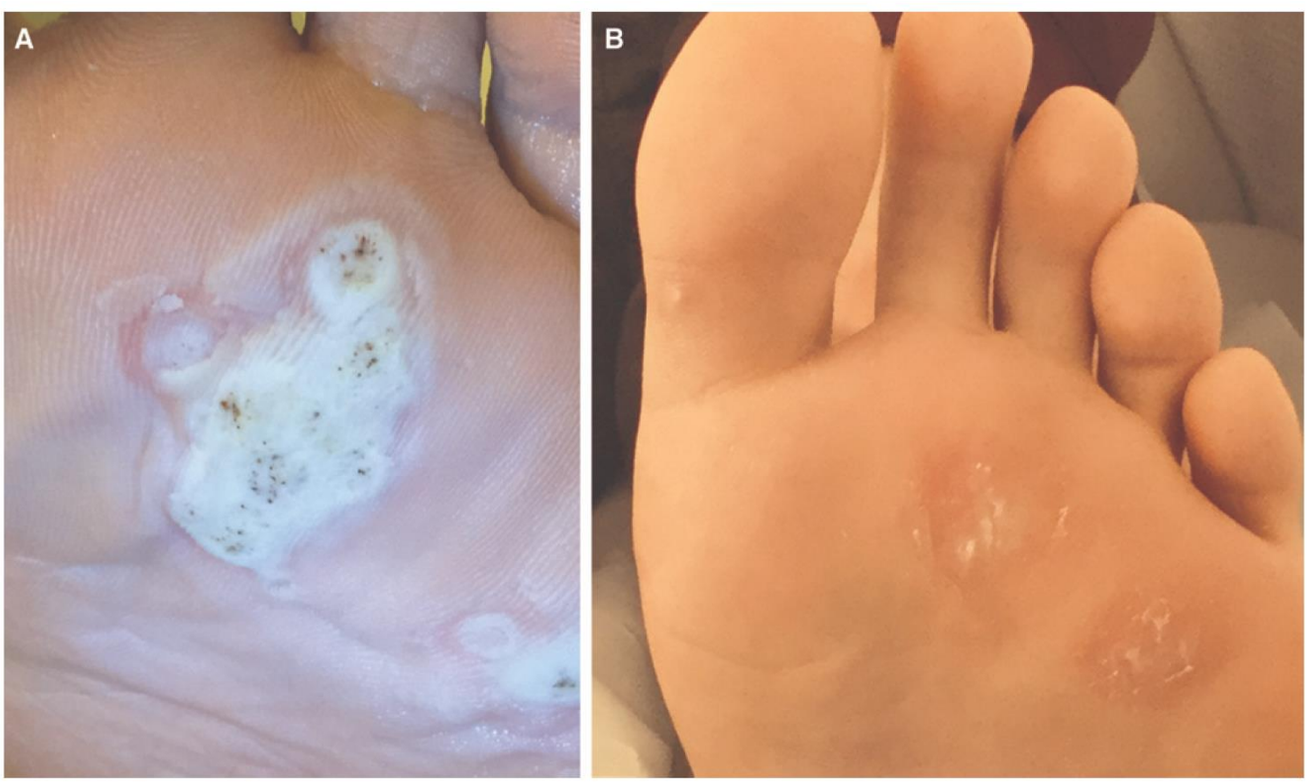

Figure 2: Patient no. 10. Left foot before the 3rd treatment (A) and 1 week after the 7th treatment (B).

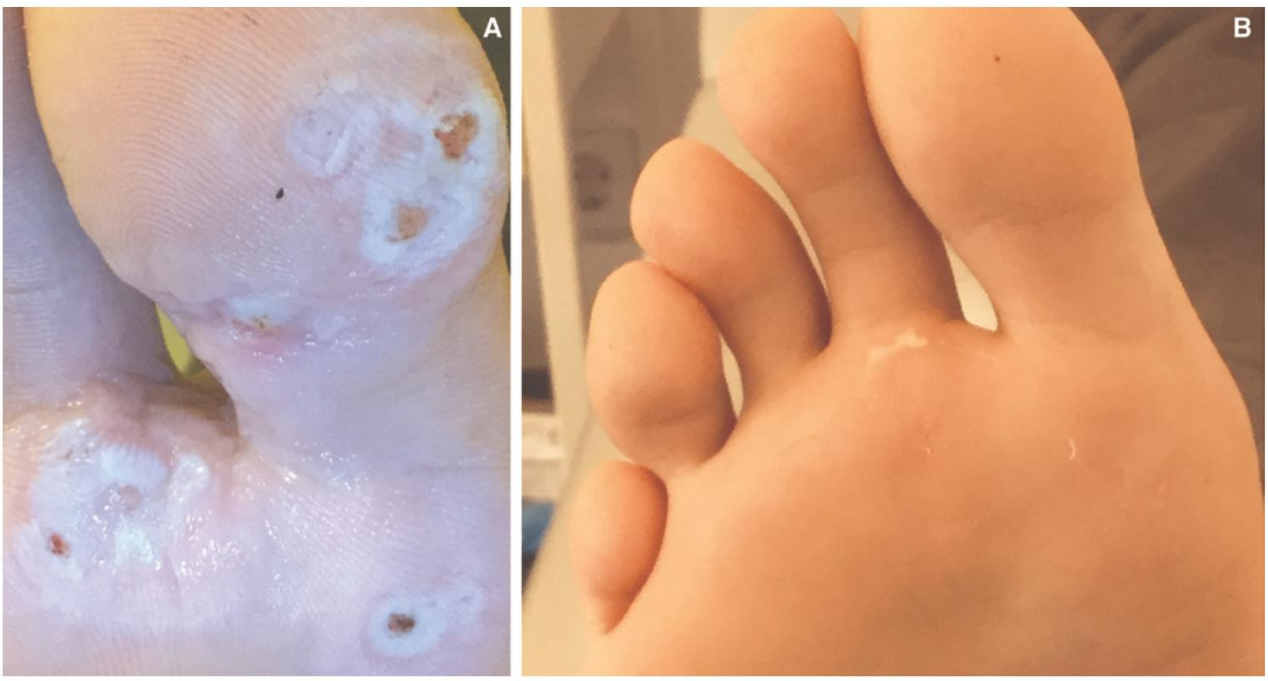

Figure 3: Patient no. 10. Right foot before the 3rd treatment (A) and 1 week after the 7th treatment (B).

Table 2: Results and side effects after treatment using a 577-nm wavelength high-power optically pumped semiconductor laser.

Patient no.	Number of sessions	VAS	Side effects	Recurrence after 6 months
1	5	4	Erythema	No
2	6	5	Erythema	No
3	3	2	–	No
4	4	6	–	No
5	12	4	Erythema	No
6	3	5	Erythema	No
7	6	5	Erythema	Yes[a]
8	5	6	–	No
9	4	4	Erythema	No
10	7	4	Blistering	No
11	5	5	Erythema	No
12	6	5	Blistering	Yes[b]

VAS, Visual analog scale.
[a]In patient no. 7 the warts did not clear at all. [b]In patient no. 12 the warts only cleared partially.

The median treatment session number was five. Typically an improvement could be seen after the second laser therapy. However, in two cases there was an improvement even after the first treatment. In contrast to another two patients, nothing could be seen until after the fourth treatment. Only two patients failed to be clear of warts despite receiving six treatments. One of them did not progress any further after the third treatment and in the other the warts did not clear at all.
Overall, the follow-up period was 6 months. No recurrences were reported during that time in 10 out of 12 patients. Most patients reported a median pain score of 5 during treatment (Table 2). If the pain was too high a cold air treatment was added. Doing this the pain assessed at least one point lower on the VAS. All of the patients who underwent CO_2 surgery and cryotherapy before laser treatment found the laser therapy less painful and more practical because of the almost wound-free therapy. Most patients experienced erythema around the treatment area. Two patients reported blistering after treatment but no patient reported local or systemic infection. No scarring was observed.

4 Discussion

When the therapy with the HOPSL was initiated, we expected an improvement for 80% of patients because the used laser is a system comparable to the 532-nm KTP laser chosen in [8]. The results showed complete clearing in 83.3% (n = 10) of the patients and were better than expected. This response rate is comparable to that achieved in studies using a PDL (73.9% [9], 75% [11] and up to 99% [13] complete clearing rate) with less additional costs as no dye kit is necessary as consumables. The treatment was well-tolerated by the patients with no need for local anesthesia and no need for needles. The therapy is quick to perform and because of the automated scanner device highly reproducible. Compared to the KTP study [8] where 25 patients were treated with a median age of 42 years, we treated younger (median age, 12 years) and fewer patients (only 12 in number). The previous treatments in our report included a failed laser therapy but none of the participants on the study had been treated with intra-lesion bleomycin. The KTP study used spot sizes of 1 mm. No information about the size of the scanned area was provided. We applied 36-ms pulses with a radiant exposure of 16–22 J/cm^2 compared to 30-ms pulses with a radiant exposure of 15–18 J/cm^2 in the KTP study. However, both pulse times are below the thermal confinement time.
We observed a complete clearance in 83% of cases with a follow-up time of 6 months compared to 48% (12 out of 25 patients) for complete clearance plus five patients with virtual clearance in the KTP study. The median number of total treatments in this study was five (range, 3–12) compared to three treatments in median in the KTP study (range, 1–8). Follow-up data was obtained in all cases after 6 months. In common with the KTP study, there was no recurrence reported in those cases who had shown complete clearance. Only two patients reported a pain score higher than 5 mitigated by adding cold air for better pain control. Most patients (7 out of 12) experienced erythema around the treatment area. Two out of 12 patients reported blistering after treatment, compared to two from 25 in the KTP study. None of the participants reported local or systemic infection. No scarring was observed as well as in the KTP study. Considering blood absorption as the target of treatment, the significantly deeper penetration of the 577 nm HOPSL comparing to the 532-nm KTP is an important point to state.

5 Conclusion

The 577 nm HOPSL laser can be a useful tool in treatment of recalcitrant warts. Compared to the KTP study [8], higher complete clearance rates could be achieved. The better clearing rates could have been influenced by the patients being younger, the deeper penetration of the 577 nm laser and higher radiant exposure. To investigate this, studies with a larger number of patients are required.

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Two-year follow-up results of copper bromide laser treatment of striae.

Longo L, Postiglione MG, Marangoni O, Melato M. J Clin Laser Med Surg. 2003 Jun;21(3):157-60.

OBJECTIVE:
The aim of our study was to follow-up 15 patients with stretch marks treated positively with the CuBr laser (577-511 nm) in 1998-99 and followed-up for 2 years.

MATERIALS AND METHODS:
The patients were Italian women, young to middle age (average 30 years old), with skin coloration classified as Fitzpatrick II-III. Biopsies were taken on some patients before the treatment and 1 month after the first treatment. Double-blind histological, histochemical and photographic evaluation was performed. Results obtained as well as to the contradictory effects reported elsewhere in the literature were compared.

RESULTS:
On average, the results were positive and there were some pathogenic considerations that justified the use of laser.

Recalcitrant viral warts: results of treatment with the KTP laser.

Gooptu C, James MP. Clin Exp Dermatol. 1999 Mar;24(2):60-3.

ABSTRACT

We report the use of a potassium-titanyl-phosphate (KTP) continuous wave laser in an open study to treat 25 patients with multiple nongenital warts that had failed to respond to conventional therapies. All patients were treated monthly using the 532 nm KTP continuous wave laser and robotic scanner. Twenty patients (80%) responded to treatment with warts: in 12 patients there was complete clearing. Moderate discomfort was reported during the procedure but subsequent morbidity was slight with no evidence of scarring. Follow-up by postal questionnaire revealed that warts recurred in those patients who had stopped treatment early but not in those whose warts had been treated to complete clearance.

EVLT

(940 nm)

Endovenous laser treatment of saphenous veins: is there clinical difference using different endovenous laser wavelenghts?

Cavallini A. Int Angiol. 2015 Feb;34(1):1-8. Int Angiol. 2015 Feb;34(1):1-8. Epub 2014 Jun 13.

ABSTRACT

Endovenous laser treatment (EVLT) is an efficient method to treat incompetent saphenous veins with high occlusion rates. Major side effects reported with 810 nm and 980 nm diode laser are postoperative pain and bruising. Recently laser systems with higher wavelengths (WSLWs), associated with new energy delivery devices, seem to reduce some side effects previously reported. Aim of this study is to verify if there are real clinical advantages in the use of WSLWs, reviewing the comparison studies present in the literature. After a search on MEDLINE database, a review of all papers concerning WSLWs, was made. Five studies of comparison between different wavelength, 810 vs. 980 nm, 940 vs. 1320 nm, 810 vs. 1320 nm, 980 vs. 1500 nm and 980 vs. 1470 nm were found. These studies report similar results: the WSLWs produce fewer side effects. New optical fibers have also been developed; WSLWs with the use of these new fibers dramatically changed the postoperative period, with a reduction of pain and bruising. There is no scientific evidence that WSLWs have any effect on long-term outcome, although short-term differences have been found for some side effects. Other parameters are also important: in particular, LEED and cold tumescent anesthesia are critical points. Laser fiber design probably has a significant effect on treatment success in the performance of EVLT and also how the energy is delivered (pulsing or continuous mode) and the pull-back rate of the laser fiber are possible factors affecting complication ratios and pain scores, regardless of the type of wavelength used.

Endovenous laser treatment (EVLT) for the saphenous reflux and varicose veins: a follow-up study.

Firouznia K, Ghanaati H, Hedayati M, Shakiba M, Jalali AH, Mirsharifi R, Dargahi A. J Med Imaging Radiat Oncol. 2013 Feb;57(1):15-20. doi: 10.1111/j.1754-9485.2012.02457.x. Epub 2012 Oct 9.

ABSTRACT

PURPOSE: The aim of this study is to report our experience about endovenous laser treatment (EVLT) for lower extremity varices in our centre which was followed by ultrasonography during the 6-month period.

METHODS: During a 1-year period, 46 patients who were treated by EVLT with the 940-nm diode laser for venous insufficiency enrolled in the study. The diagnosis of greater saphenous vein (GSV) incompetence with reflux was made by clinical evaluation and duplex Doppler examinations. Clinical outcomes, complications and duplex ultrasound of the GSV were assessed within 1 week, 1 month, 3 months and 6 months, after the endovascular laser treatment.

RESULTS: The mean age of our patients was 44 ± 11 years (24-70), and among them, 23 (50%) were male. Improvement in visible varicosity was seen in 39 (84.8%) patients after 6 months (P value = 0.011). The baseline mean diameter of GSV was 4.9 ± 1.6 mm and it dropped to 3.5 ± 1.3 after 6 months (P < 0.0001). After 6 months, 95.7% of our patients were satisfied and recommended this procedure to others.

CONCLUSIONS: Endovascular laser ablation seems to be a safe and effective method for the treatment of lower limb varices.

Endovenous treatment of the greater saphenous vein with a 940-nm diode laser: thrombotic occlusion after endoluminal thermal damage by laser-generated steam bubbles.

Proebstle TM1, Lehr HA, Kargl A, Espinola-Klein C, Rother W, Bethge S, Knop J. J Vasc Surg. 2002 Apr;35(4):729-36.

ABSTRACT

PURPOSE: Despite a rapid spread of the technique, very little is known about the laser-tissue interaction in endovenous laser treatment (EVLT). We evaluated EVLT of the incompetent greater saphenous vein (GSV) for efficacy, treatment-related adverse effects, and putative mechanisms of action.

METHODS: Twenty-six patients with 31 limbs of clinical stages C(2-6), E(P), A(S,P), P(R) with incompetent GSV proven by means of duplex scanning were selected for EVLT in an outpatient setting. A 600-microm fiber was entered into the GSV via an 18-gauge needle below the knee and proceeded to the saphenofemoral junction (SFJ). After infiltration of tumescent local anesthesia, multiple laser pulses of 15 J energy and a wavelength of 940 nm were administered along the vein in a standardized fashion. D-dimers were determined in peripheral blood samples 30 minutes after completion of EVLT in 16 patients and on postoperative day 1 in 20 patients. One GSV that was surgically removed after EVLT was examined by means of histopathology. Additionally, an experimental in vitro set-up was constructed as a means of investigating the mechanism of laser action within a blood-filled tube.

RESULTS: A median of 80 laser pulses (range, 22-116 laser pulses) were applied along the treated veins. On days 1, 7, and 28, all limbs except one (97%) showed a thrombotically occluded GSV. In one patient, the vessel showed incomplete occlusion. The distance of the proximal end of the thrombus to the SFJ was a median 1.1 cm (range, 0.2-5.9 cm) in the remaining patients. Adverse effects in all 26 patients were ecchymoses and palpable induration along the thrombotically occluded GSV that lasted for 2 to 3 weeks. In two limbs (6%), thrombophlebitis of a varicose tributary required oral treatment with diclofenac. D-dimers in peripheral blood were tested with normal results in 14 of 16 patients 30 minutes after completion of the procedure and elevated results in 7 of 20 patients at day 1 after EVLT. However, an increase of D-dimers from day 0 to day 1 was observed in 15 of the 16 patients undergoing tests 30 minutes after EVLT and on day 1. The 940-nm laser was demonstrated by means of in vitro experiments and the histopathological examination of one explanted GSV to act by means of indirect heat damage of the inner vein wall.

CONCLUSION: EVLT of the GSV with a 940-nm diode laser is effective in inducing thrombotic vessel occlusion and is associated with only minor adverse effects. Laser-induced indirect local heat injury of the inner vein wall by steam bubbles originating from boiling blood is proposed as the pathophysiological mechanism of action of EVLT.

Thermal damage of the inner vein wall during endovenous laser treatment: key role of energy absorption by intravascular blood.

Proebstle TM1, Sandhofer M, Kargl A, Gül D, Rother W, Knop J, Lehr HA. Dermatol Surg. 2002 Jul;28(7):596-600.

ABSTRACT

BACKGROUND: Despite the clinical efficacy of endovenous laser treatment (EVLT), its mode of action is incompletely understood.

OBJECTIVE: To evaluate the role of intravascular blood for the effective transfer of thermal damage to the vein wall through absorption of laser energy.

METHODS: Laser energy (15 J/pulse, 940 nm) was endovenously administered to explanted greater saphenous vein (GSV) segments filled with blood (n = 5) or normal saline (n = 5) in addition to GSVs under in vivo conditions immediately prior to stripping. Histopathology was performed on serial sections to examine specific patterns of damage. Furthermore, in vitro generation of steam bubbles by different diode lasers (810, 940, and 980 nm) was examined in saline, plasma, and hemolytic blood.

RESULTS: In saline-filled veins, EVLT-induced vessel wall injury was confined to the site of direct laser impact. In contrast, blood-filled veins exhibited thermal damage in more remote areas including the vein wall opposite to the laser impact. Steam bubbles were generated in hemolytic blood by all three lasers, while no bubbles could be produced in normal saline or plasma.

CONCLUSION: Intravascular blood plays a key role for homogeneously distributed thermal damage of the inner vein wall during EVLT.

NAIL TREATMENT

(980 nm)

Laser therapy of onychomycosis.

Nenoff P1, Grunewald S, Paasch U. J Dtsch Dermatol Ges. 2014 Jan;12(1):33-8. doi: 10.1111/ddg.12251. Epub 2013 Nov 18. Review.

ABSTRACT

Since 2010 the FDA has approved laser systems as capable of producing a "temporary increase in clear nails" in patients with onychomycosis. Fungal eradication is probably mediated by heat in infrared laser systems; their efficacy has been confirmed thermographically, histologically and in electron microscopy. Another approach to decontaminate the nail organ is to disrupt fungi and spores by q-switched pulse applications. Recently specific combinations of wavelengths have been tested for their ability to disrupt the mitochondrial transmembrane potential at physiological temperatures by generating ATP and ROS. While clinically extremely high clearance rates of approximately 87.5-95.8 % have been reported, in-vitro investigations have failed to confirm the clearance. The variety of systems and advised parameters hampers a systematic evaluation. Recommendations for safe and practical treatment protocols, informed consent items, and combination with conventional treatment options are all areas of active work. Currently there is a lack of data concerning the long-term efficacy of laser therapy of onychomycosis; certified treatment protocols are needed.

Antifungal efficacy of lasers against dermatophytes and yeasts in vitro.

Paasch U, Mock A, Grunewald S, Bodendorf MO, Kendler M, Seitz AT, Simon JC, Nenoff P. Int J Hyperthermia. 2013 Sep;29(6):544-50. doi: 10.3109/02656736.2013.823672.

PURPOSE:
Approximately 2-13% of the world population suffers from onychomycosis. Recently, lasers have been introduced for treatment. However, no effect was found with in vitro laser irradiation of pathogens on agar plates. This study aimed to investigate the efficacy of laser irradiation against fungi using an alternative in vitro approach.

MATERIALS AND METHODS:
Lasers of 808, 980 and 1064 nm were used to heat cell culture media and a nail clipping. Trichophyton rubrum. T. interdigitale. Microsporum gypseum. Candida albicans. C. parapsilosis, and C. guilliermondii species were subcultured and subjected to laser treatments (808/980 nm: 9-27 J/cm(2), 6 ms, 12 × 12 or 12 × 50 mm and 1064 nm: 50-240 J/cm(2), 90 ms, 5-10 mm). After irradiation, the fungal elements were transferred onto agar plates using conventional and Drigalski spatulas and were incubated for 6 days.

RESULTS:
The highest increase in temperature was found using a 980-nm laser with a pulse duration of 6 ms and a fluence of 27 J/cm(2). The histology work-up revealed a dissection of the nail plate from the nail bed tissue after laser irradiation. Growth inhibition was only found for C. guilliermondii and T. interdigitale. All other pathogens presented only reduced growth, and C. albicans growth was unaffected.

CONCLUSIONS:
This study demonstrates a clear thermal effect for linear scanning 980-nm and long-pulsed 1064-nm laser systems on either nail clippings or cell culture media. Complete pathogen growth impairment was achieved if temperatures were measured above 50 °C. The results for the 1064-nm system were almost comparable to 980 nm results.

Heat profiles of laser-irradiated nails.

Paasch U, Nenoff P, Seitz AT, Wagner JA, Kendler M, Simon JC, Grunewald S. J Biomed Opt. 2014 Jan;19(1):18001. doi: 10.1117/1.JBO.19.1.018001.

ABSTRACT

Onychomycosis is a worldwide problem with no tendency for self-healing, and existing systemic treatments achieve disease-free nails in only 35 to 76% of cases. Recently, treatment of nail fungus with a near-infrared laser has been introduced. It is assumed that fungal eradication is mediated by local heat. To investigate if laser treatment has the potential to eradicate fungal hyphae and arthrospores, laser heat application and propagation needs to be studied in detail. This study aimed to measure nail temperatures using real-time videothermography during laser irradiation. Treatment was performed using 808- and 980-nm linear scanning diode lasers developed for hair removal, enabling contact-free homogeneous irradiation of a human nail plate in one pass. Average and peak temperatures increased pass by pass, while the laser beam moved along the nail plates. The achieved mean peak temperatures (808 nm: 74.1 to 112.4°C, 980 nm: 45.8 to 53.5°C), as well as the elevation of average temperatures (808 nm: 29.5 to 38.2°C, 980 nm: 27.1 to 32.6°C) were associated with pain that was equivalent to that of hair removal procedures and was not significantly different for various wavelengths. The linear scanning laser devices provide the benefits of contact-free homogeneous heating of the human nail while ensuring adequate temperature rises.

VAPORIZATION OF SOFT TISSUE

(980 nm)

Evaluation of safety and efficacy of 980-nm diode laser-assisted lipolysis versus traditional liposuction for submental rejuvenation: A randomized clinical trial.

Valizadeh N, Jalaly NY, Zarghampour M, Barikbin B, Haghighatkhah HR. J Cosmet Laser Ther. 2015 Jul 3:1-6

ABSTRACT

BACKGROUND:
Submental fat accumulation and skin laxity is a frequent concern of cosmetic patients.

OBJECTIVE:
The aim of this randomized prospective controlled clinical trial was to compare the efficacy and safety of laser-assisted lipolysis and liposuction in the submental rejuvenation.

MATERIAL AND METHODS:
Thirty-six female adults were enrolled in this clinical trial and were categorized into two groups: group 1 underwent 980-nm diode laser with the power of 6-8 W and group 2 underwent traditional liposuction. Patients were evaluated with ultrasonography 2 weeks and 2 months after the procedures.

RESULTS:
Ultrasonographic evaluation reported the significant reduction of fat thickness in each group compared with the baseline (p value < 0.001). At the 2 weeks and 2 months follow-up visit, fat thickness reduction was significantly higher in the lipolysis group (p value < 0.05). Overall patients' satisfaction in lipolysis group was higher than liposuction with 11 (61%) of lipolysis patients being very satisfied in contrast to 10 (55.5%) of liposuction patients reporting "dissatisfied or neutral" results.

CONCLUSION:
Laser-assisted lipolysis using 980-nm diode is approved to be safe and effective for skin tightening and rejuvenation of the submental area and seems to be a better option than traditional techniques for treatment of this cosmetic problem.

Laser assisted lipolysis for neck and submental remodeling in Rohrich type I to III aging neck: a prospective study in 30 patients.

Leclère FM1, Moreno-Moraga J, Alcolea JM, Casoli V, Mordon SR, Vogt PM, Trelles MA. J Cosmet Laser Ther. 2014 Dec;16(6):284-9. doi: 10.3109/14764172.2014.946053. Epub 2014 Sep 19.

ABSTRACT

BACKGROUND:
Since the first studies by Apfelberg in 1994 and the mathematical model by Mordon in 2004, laser lipolysis (LAL) has been on the rise. Laser lipolysis has the advantages of reduced operator fatigue, excellent patient tolerance, quick recovery time, as well as the additional benefit of dermal tightening. This article reports our experience with laser-assisted lipolysis (LAL) in submental and neck remodelling.

METHODS:
Between June 2010 and January 2013, a prospective study was performed on 30 patients treated for Rohrich type I to III aging neck, with LAL. The laser used in this study was a 980 nm diode laser (Quanta system, spa model D-plus, Solbate Olona (VA), Italy). Laser energy was transmitted through a 600 µm optical fiber and delivered in a continuous mode 15 W power. Previous mathematical modelling suggested that 0.1 kJ was required in order to destroy 1 ml of fat. Patients were asked to fill out a satisfaction questionnaire. The cervicomental angle was measured 6 months post-operatively and compared with the preoperative values.

RESULTS:
Other than three patients who developed mild hyperpigmentation that disappeared after 4 months, there were no complications in the series. Pain during the anaesthesia and discomfort after the procedure were minimal. The time taken to return to normal activities was 3.2 ± 1 days. All patients would strongly recommend this treatment. Overall satisfaction was high with both patients and investigators and was validated by decrease in cervicomental angle demonstrating a systematic decrease in fat thickness and improved skin tightening.

CONCLUSION:
LAL is a safe and reproducible technique for remodeling in Rohrich type I to III aging neck. The procedure allows for a reduction in the amount of adipose deposits while providing concurrent skin contraction.

Results of Laser assisted Lipolysis using a 980 nm diode Laser

Yann Renoulet, MD. 2010. Plastic and Reconstructive Surgery Center, Center for Lasertherapy, Elisabeth Krankenhaus Recklinghausen, Recklinghausen, Germany

Background

Laser assisted lipolysis devices are used to heat the adipose and connective tissue as adjunction to liposuction by improving skin laxity and providing hemostasis. With this new technique patients benefit of enhanced body shaping and skin tightening with reduced patient downtime. The efficacy of the 980-nm diode laser for laser lipolysis were evaluated in different body areas

Materials and Methods

Patients were treated with a continuous-wave (CW) power 980-nm diode laser system (QuadroStar+ 980 made by Asclepion Laser Technologies in Jena, Germany). We treated the under lid, submental area, arms, elbow, abdomen, vulva and flanks. A 300 µm fiber was used to treat the face and on all other areas a 600 µm fiber was used to perform the laser lipolysis

Results

Patients observed good to excellent skin textural improvement associated with efficient removal of unwanted fat. And since laser lipolysis is an outpatient procedure, patients were able to resume normal daily activities after 24 h.

Conclusion

Our clinical findings clearly demonstrate that the use of the new QuadroStar+ 980 diode laser system provides safe and efficacious body shaping, fat reduction and enhanced skin tightening. Most of our patients experienced a very pleasing clinical outcome with significant reduction in fat tissue and a smoother and tighter skin appearance with minimal downtime. This in general resulted into a high patient satisfaction.

Introduction

Body reshaping and fat removal has become a very popular desire in our actual modern society. This is one reason why liposuction procedures increasingly continue to be one of the most popular treatment options performed in aesthetic surgery today.

Laser assisted lipolysis which is FDA approved as a method since 2006 is a relatively new, but very effective application which has been developed to improve the traditional method of vacuum assisted liposuction. By using thin fiber optics and a powerful light delivery system, specific Laser wavelengths are precisely transmitted. They interact within the subcutaneous tissue layer selectively heating the target structures (fat layer and fibrous septae only) by use of a well known physical effect called selective photothermolysis.

This technology was already introduced in North America in 1994 and the used pulsed 1064- nm Nd:YAG laser has proven to be safe and effective using a so called wet technique, were a canula of 1 mm in diameter is inserted into the fat tissue during the treatment. Previous histological analyses of human fat tissue treated with this Nd:YAG laser showed reversible and irreversible cell and tissue damage and a significant reduction in bleeding when compared to conventional liposuction.

This study aimed to prove the efficacy of laser assisted lipolysis with a new 980-nm diode Laser (QuadroStar+ 980) manufactured by Asclepion Laser Technologies, Jena, Germany

Materials and Methods

We performed all treatments using a 980-nm high power (25 Watt) diode laser (QuadroStar+ 980, Asclepion Laser Technologies, Jena, Germany, Fig. 1) The laser works in a so called continuous emission mode (CW mode) which provides a very safe and constant absorption on fat tissue.

A special 300- µm and a 600- µm optical fiber delivery system (Fig.2-3) has been used for the treatment of different body areas. Power settings in (Watt) are adjusted and optimized as a important parameter required to be most effective for the treated area: We have used 5 Watt for the face and chin, 10 Watts for arms and elbow and 25 Watts on all abdominal treatment areas. A bright aiming beam (red color) at the end of the optical fiber ensures a precise visualization of the current position through transcutaneous illumination of the treated area (Fig.4).

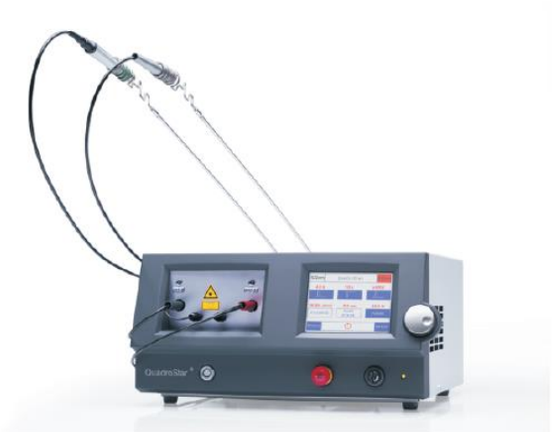


Fig. 1: QuadroStar+ 980, a modern high power table top diode Laser with 532-nm and 980-nm dual wavelength laser output made by Asclepion Laser Technologies, Jena

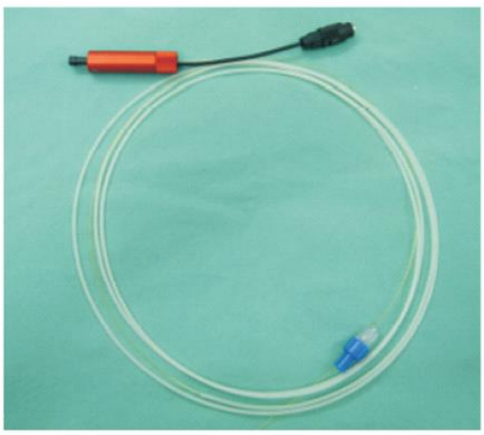


Fig. 2: High precision (300µm in diameter) optical fiber delivery system developed and manufactured by Asclepion Laser Technologies, Jena, Germany

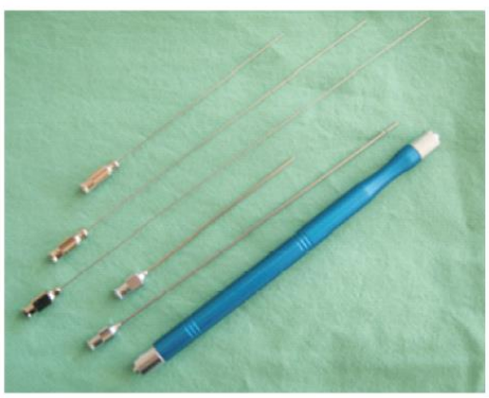


Fig. 3: High precision Laser lipolysis set manufactured by Asclepion Laser Technologies, Jena, Germany. Handpiece for 600µm optical fiber with a canula length of 15 cm and 8 cm.

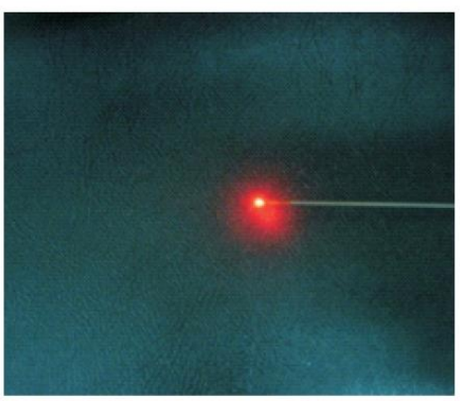


Fig. 4: Bright red aiming beam output for clear visualisation of the current position with a 300µm fiber set during the treatment.

Handpiece for 300µm optical fiber with a canula length of
15 cm, 10 cm and 8 cm

Technique

All procedures were performed following a strictly outpatient clinic setting as recommended by the American Society for Dermatologic Surgery. The areas to be treated were marked with a surgical marker first. Afterwards the treatment areas have been further prepared, disinfected and draped in sterile fashion. We used the standard wet infiltration technique with Klein'sche solution in all our cases. After infiltration of the tumescent solution a 1mm stitch incision was made with a # 11 blade. The microcanula was then inserted through the incision point into the subcutaneous fat layer and moved according to the recommended fan technique in different layers of the skin parallel to the surface. We tried to maintain a constant speed of approximately 10cm per second. During the entire laser lipolysis procedure protective eyewear was used by the patient and the staff. After laser lipolysis, the liquefied fat was aspirated using a high vacuum liposuction device. After the procedure and the following end disinfection a compressive garment was applied to the treatment area. The patients have been instructed to wear the compressive garment day and night for almost 7 days and for a period of 2 more weeks just during the night.

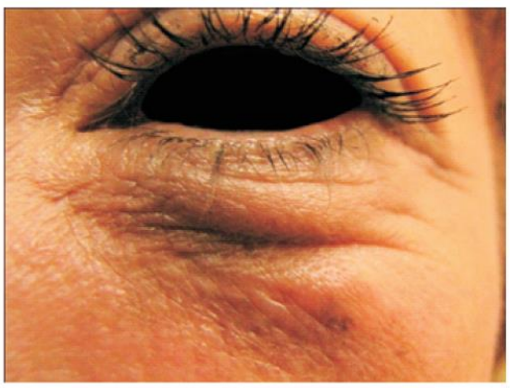
Results

Since July 2009, 53 cases of laser Lipolysis have been sucessfully performed using this new diode Laser

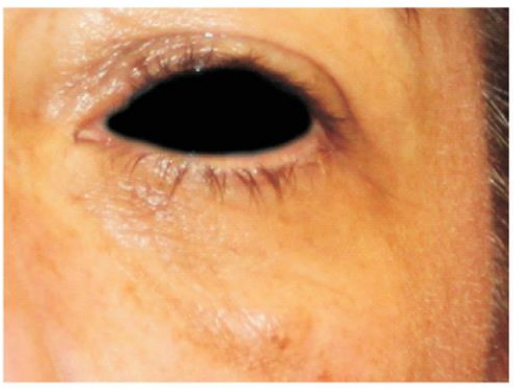
Treated body areas:		**Energy used per area:**					
Under lid:	3	Under lid:	468	to	535	J	per side
Chin:	7	Chin:	4796	to	5582	J	
Upper arms:	10	Upper arms:	6182	to	11282	J	per side
Elbows:	4	Elbows:	3454	to	4778	J	per side
Abdomen:	21	Abdomen:	23886	to	27992	J	
Flanks:	7	Flanks:	8732	to	12745	J	per side
Vulva:	1	Vulva:	2531			J	

Results

48 year old patient

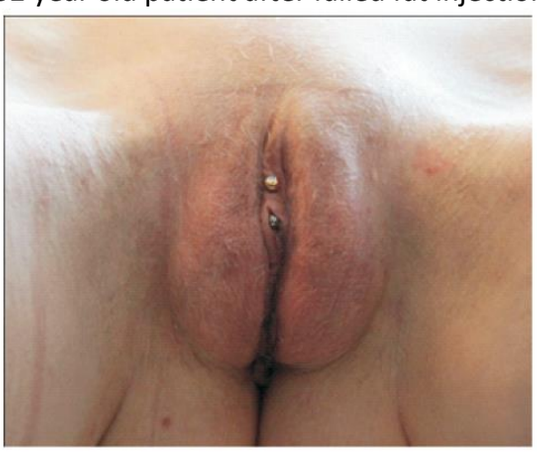


Before

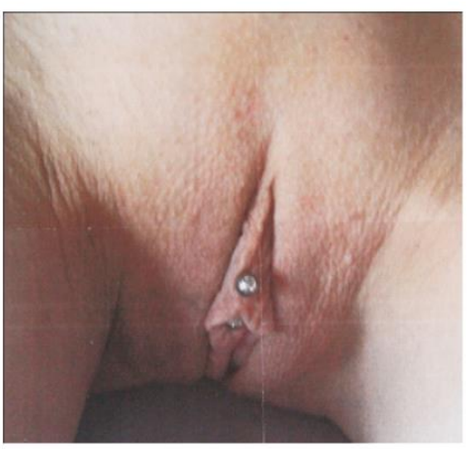


After 4 months

52 year old patient after failed fat injection



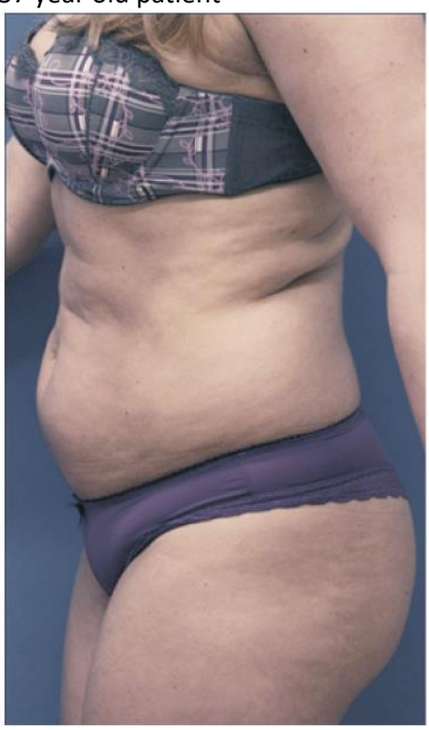
Before



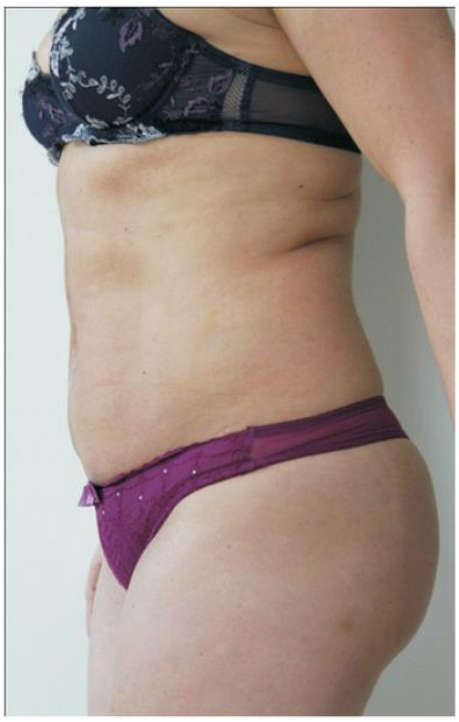
After 1 week

Results

37 year old patient

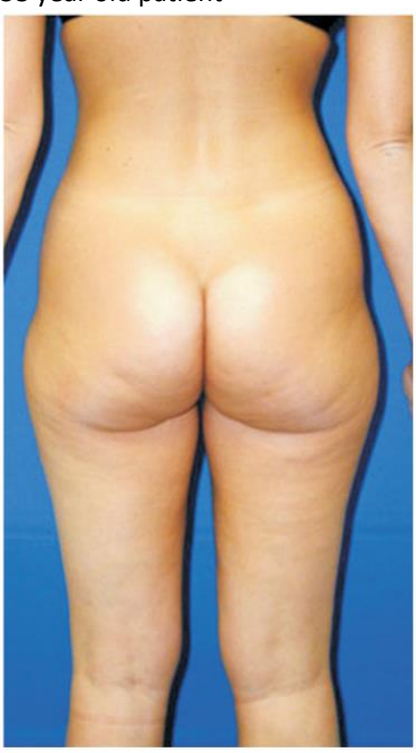


Before

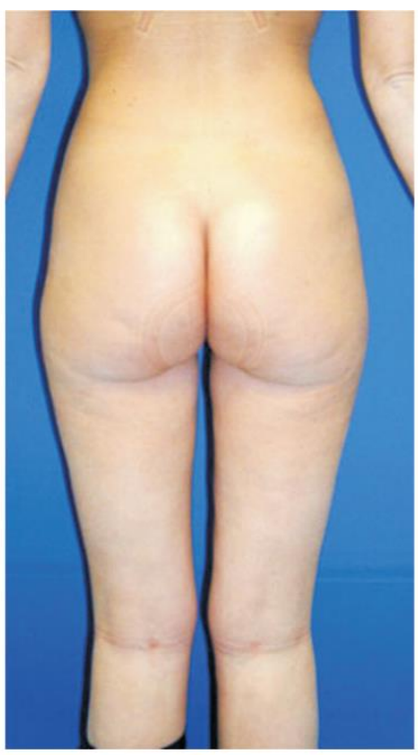


After 1 week

38 year old patient

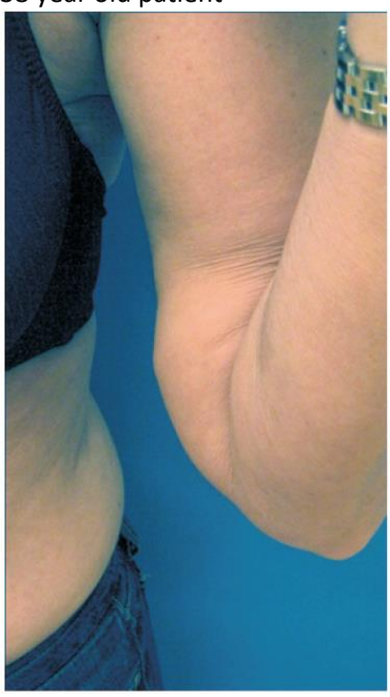


Before

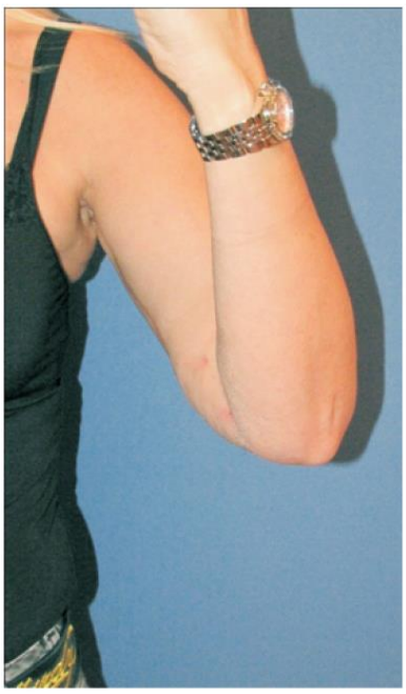


After 1 month

38 year old patient



Before



After 1 month

All of our patients returned to work on the very next day after procedure. The post operative pain could be treated with non steroidal anti-inflammatory drug such as ibuprofen at a dose of 800mg (1-1-1) for a period of 3 days if required.

Clinical results were excellent with remarkable improvements in 100% of our patients. All patients reported a high level of satisfaction and some asked for further treatment of other areas. All patients appreciated the minimal downtime and the tightening and smoothing of their skin structure as a final result of the treatment.

Discussion

Clinical experience and previous studies have shown that proper heating of the dermis provides additional skin retraction. The first studies were proposed with a Nd:YAG laser with a wavelength of 1064-nm but laser lipolysis is still a new technique under development. Our actual clinical experience with the new 980nm diode laser in CW mode confirmed that excellent clinical outcome and reproducable results can be performed. The very high patient satisfaction proved the efficacy and safety of this new diode Laser procedure. The ease of the treatment, especially in difficult-to-treat regions such as the submental region and the under lid area may be explained by the possibility to use very small 300 µm fibers with the QuadroStar+ 980.

Conclusion

The study demonstrates that the removal of fat with simultaneous tissue contraction due to collagen fragmentation and inflammatory response can be effectively performed in all body areas using the QuadroStar+ 980-nm diode laser (Asclepion Laser Technologies, Jena, Germany).

Safety of Laser assisted Lipolysis using a 980 nm diode Laser

Yann Renoulet, MD. 2010. Plastic and Reconstructive Surgery Center, Center for Lasertherapy, Elisabeth Krankenhaus Recklinghausen, Recklinghausen, Germany

Background

Laser assisted lipolysis devices are used to heat the adipose and connective tissue as adjunction to liposuction by improving skin laxity and providing hemostasis. With this new technique patients benefit of significant enhanced body shaping and skin tightening results with reduced patient downtime. The safety of a new 980-nm diode laser for laser lipolysis were evaluated using resected full skin followed by histological analyses.

Materials and Methods

After abdominal dermolipectomie a 300 µm and a 600 µm fiber was used to perform a Laser lipolysis. We used the new powerful QuadroStar+ 980 diode laser from Asclepion Laser Technologies, Jena. After using different parameters varying Energy, Power and Time the skin samples with the complete fat layer have been histologically analyzed.

Results

The histological analysis clearly confirmed the safeness of this new CW (continuous wave) diode technique which left the epidermal layer fully intact without any modifications but produced significant and selective thermal effects on the adipose and connective target tissue.

Conclusion

The study demonstrate and confirm the safeness in performing Laser assisted lipolysis procedures with the new Asclepion QuadroStar+ 980 diode laser. The safety profile of this new laser allows to perform effective treatment procedures resulting in significant improved clinical outcome while minimizing side effects and damage of the epidermal layer.

Introduction

Body reshaping and fat removal has become a very popular desire in our actual modern society. This is one reason why liposuction procedures increasingly continue to be one of the most popular treatment options performed in aesthetic surgery today.

Laser assisted lipolysis which is FDA approved as a method since 2006 is a relatively new but very effective application which has been developed to improve the traditional method of vacuum assisted liposuction. By using thin fiber optics and a powerful light delivery system, specific Laser wavelengths are precisely transmitted. They interact within the subcutaneous tissue layer selectively heating the target structures (fat layer and fibrous septae only) by use of a well known physical effect called selective photothermolysis.

This technology was already introduced in North America in 1994 and the used pulsed 1064- nm Nd:YAG laser has proven to be safe and effective using a so called wet technique, were a canula of 1 mm in diameter is inserted into the fat tissue during the treatment. Previous histological analyses of human fat tissue treated with this Nd:YAG laser showed reversible and irreversible cell and tissue damage and a significant reduction in bleeding when compared to conventional liposuction.

This study aimed to prove the safeness of laser assisted lipolysis with a new 980-nm diode Laser (QuadroStar+ 980) manufactured by Asclepion Laser Technologies, Jena, Germany

Materials and Methods

We performed all treatments using a 980-nm high power (25 Watt) diode laser (QuadroStar+ 980, Asclepion Laser Technologies, Jena, Germany, Fig. 1). The laser works in a so called continuous emission mode (CW mode) which provides a very safe and constant absorption on fat tissue.

A special 300-µm and a 600-µm optical fiber delivery system (Fig.2-3) has been used for the treatment of different body areas. Power settings in (Watt) are adjusted and optimized as an important parameter required to be most effective for the treated area: We have used 5 Watt for the face and chin, 10 Watts for arms and elbow and 25 Watts on all abdominal treatment areas. A bright aiming beam (red color) at the end of the optical fiber ensures a precise visualization of the current position through transcutaneous illumination of the treated area (Fig.4).

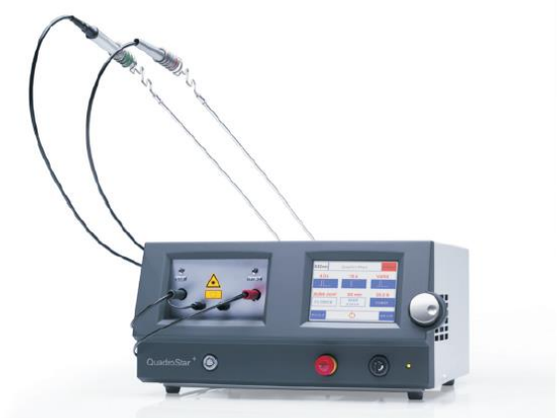


Fig. 1: QuadroStar+ 980, a modern high power table top diode Laser with 532-nm and 980-nm dual wavelength laser output made by Asclepion Laser Technologies, Jena

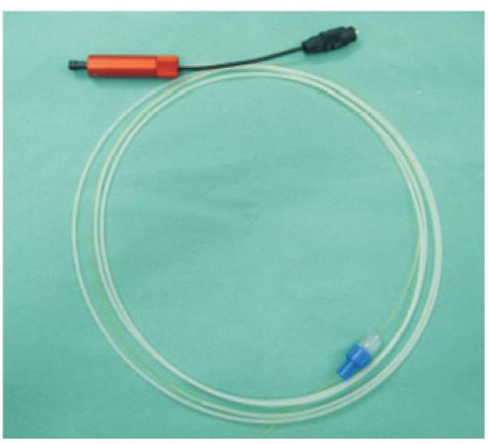


Fig. 2: High precision (300µm in diameter) optical fiber delivery system developed and manufactured by Asclepion Laser Technologies, Jena, Germany

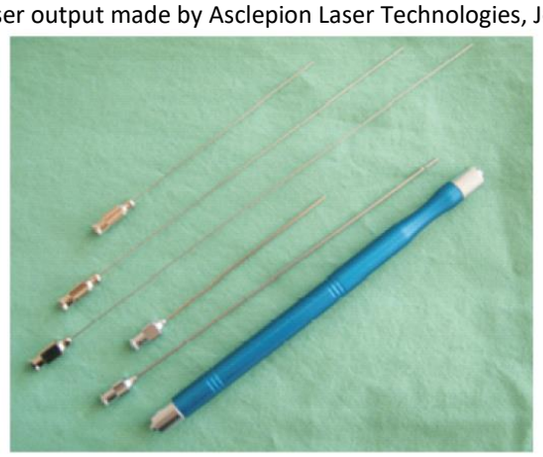


Fig. 3: High precision Laser lipolysis set manufactured by Asclepion Laser Technologies, Jena, Germany.
Handpiece for 600µm optical fiber with a canula length of 15 cm and 8 cm.
Handpiece for 300µm optical fiber with a canula length of 15 cm, 10 cm and 8 cm

Fig. 4: Bright red aiming beam output for clear visualisation of the current position with a 300µm fiber set during the treatment.

Technique

After abdominal dermolipectomie the resected full skin has been used to test different parameters of the laser as energy, power and time. Histological analyses were made from all test areas.

First we used the same power (5 Watt with the 300- µm fiber and 20 Watt with the 600- µm fiber in CW modus) in different layers of the skin moving parallel to the surface and maintaining a constant movement speed of 10cm per second. This protocol was used to demonstrate the effects of a standard performed laser lipolysis

In a second scenario we have modified the applied energy within a range from 0 Joule to 380 Joules but without any movement of the canula which has been placed in the upper layer of the subcutis. This protocol was used to prove the safety of the procedure even in case the surgeon does not perform the recommended proper technique.

Results

The histological analysis of the full skin layer cross section after application of energy with a canula (300- µm) and a speed of 10cm per second has shown a 500- µm tunnel formation (Fig.5) with no epidermal destruction (Fig.6).

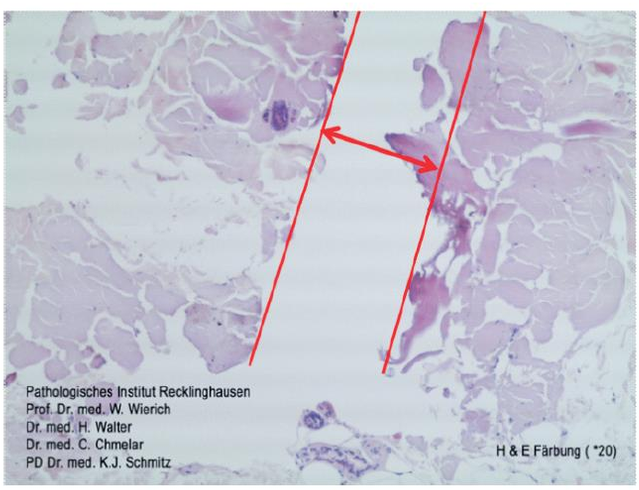


Fig. 5: 500-µm tunnel formation after the use of a thin 300 µm optical fiber

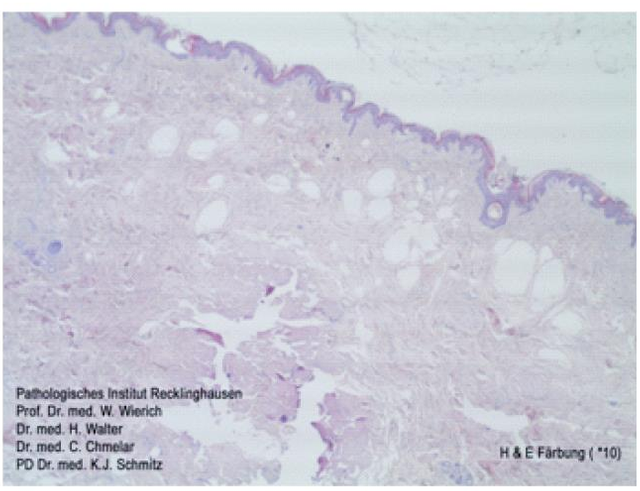


Fig. 6: No signs of epidermal destruction by using the 300-µm optical fiber inserted in the upper layer of the subcutis

Additional histology findings confirmed a perivascular inflammatory response (Fig. 7-9). In the subcutis histological analyze can show a fragmentation of the collagen (Fig.10)

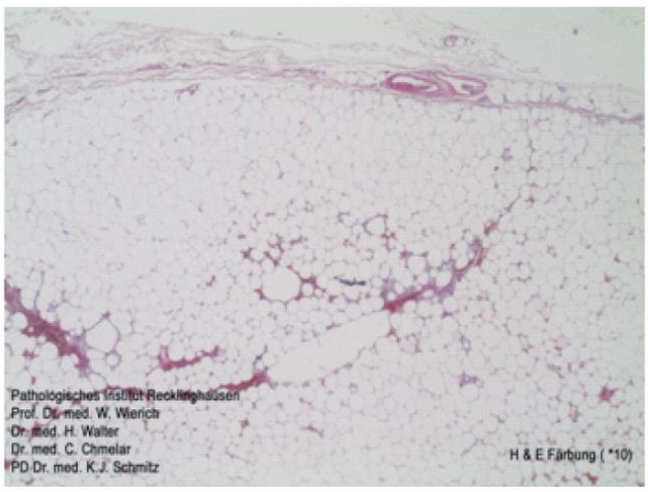


Fig. 7: 10x magnification. Perivascular inflammatory response

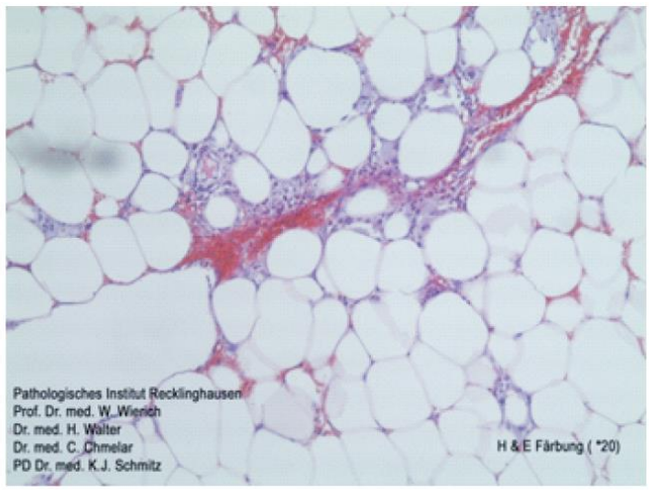


Fig. 8: 20x magnification. Perivascular inflammatory response

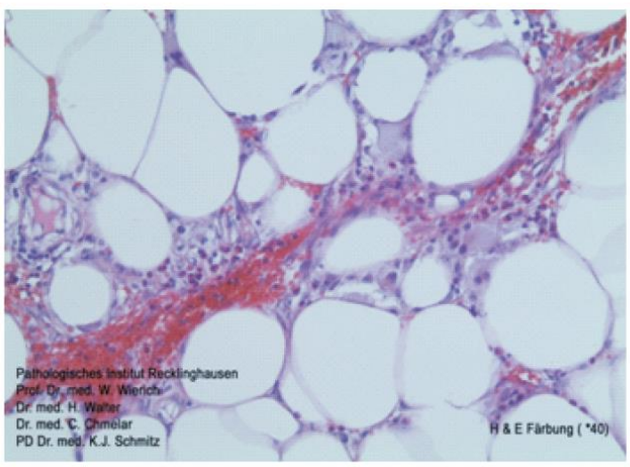


Fig. 9: 40x magnification. Perivascular inflammatory response

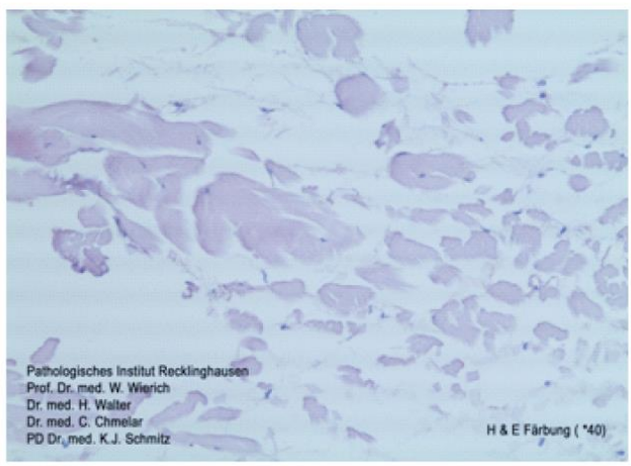


Fig. 10: 40x magnification. Collagen fragmentation. Histological analysis of the subcutis cross section shows a fragmentation of the collagen (Fig.10)

In the second part of the study we applied different amounts of energy in the upper layer of the subcutis but without moving the canula in a defined pattern (Fig.11).

60 J	100 J	140 J	180 J	220 J	0 J
260 J	300 J	0 J	340 J	380 J	No Canula

Fig. 11 Pattern of applied energy

In order to be sure not to interfere with the histological analyses we did not communicate the pattern to the pathologist. And in one area we have not given informations that no canula was inserted. (Fig.12)

No Canula	No Tunnel
0 J	Tunnel without Modification of adipocytes
60 J	Tunnel without Modification of adipocytes
100 J	Tunnel without Modification of adipocytes (Fig.13-14)
140 J	Tunnel, Homogenization in the Dermis, (Fig.15-16)
180 J	Tunnel, Homogenization in the Dermis, pale adipocytes
220 J	Tunnel, Homogenization in the Dermis, pale adipocytes (Fig.17-18)
260 J	Tunnel, Homogenization in the Dermis, pale adipocytes
300 J	Tunnel, Homogenization in the Dermis, pale adipocytes
340 J	Tunnel, Homogenization in the Dermis, pale adipocytes, Subepidermal vescia
380 J	Tunnel, Homogenization in the Dermis, pale adipocytes, Necrosis of Fat Tissue

Fig. 12 Results dependant on the applied energy

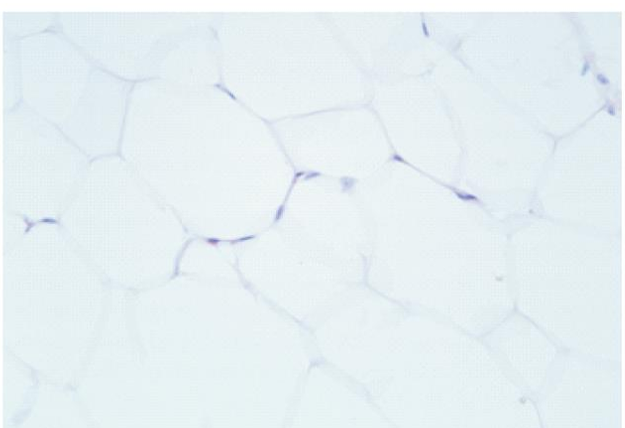


Fig. 13: 200x magnification. 100-J applied energy. Swollen lipocyte nucleous and partly lost of nucleous

Fig. 14: 200x magnification. 100-J applied energy. Swollen lipocyte nucleous and partly lost of nucleous

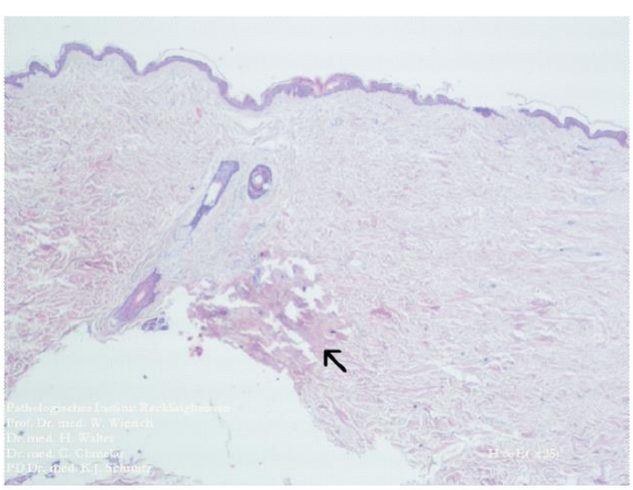


Fig. 15: 25x magnification. 140-Joule applied energy. Homogenization in the dermis

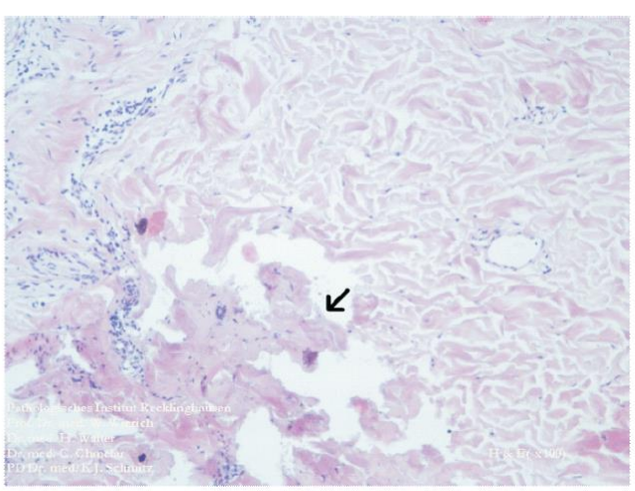


Fig. 16: 100x magnification. 140-Joule applied energy. Homogenization in the dermis

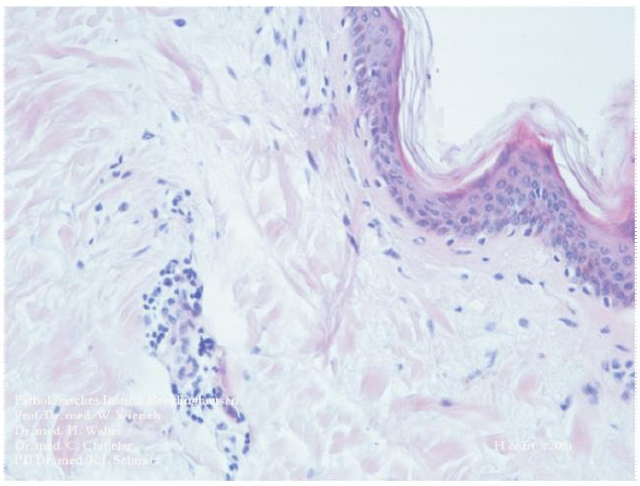


Fig. 17: 200x magnification. 220-Joule applied energy. Perivascular lymphocytic inflammation

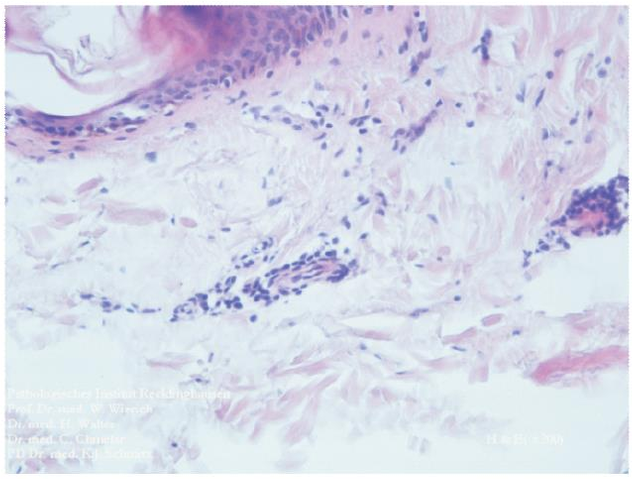


Fig. 18: 200x magnification. 220-Joule applied energy. Perivascular lymphocytic inflammation

Discussion

In the first part of the study, histological analyses could prove the efficient removal of fat with simultaneous tissue contraction due to collagen fragmentation and inflammatory response. The epidermal layer remains to be totally uneffected without any sign of destruction or damage.

The used 980-nm wavelength has an absorption coefficient in fat tissue of a=1,417-m-1 (R.L.P. van Veen and H.J.C.M. Sterenborg, A. Pifferi, A. Torricelli and R. Cubeddu, Annual BIOMED Topical Meeting, 2004). The absorption coefficient in water is a=43-m-1 (G. M. Hale and M. R. Querry, Appl. Opt., 12, 555--563, 1973) (Fig. 19)

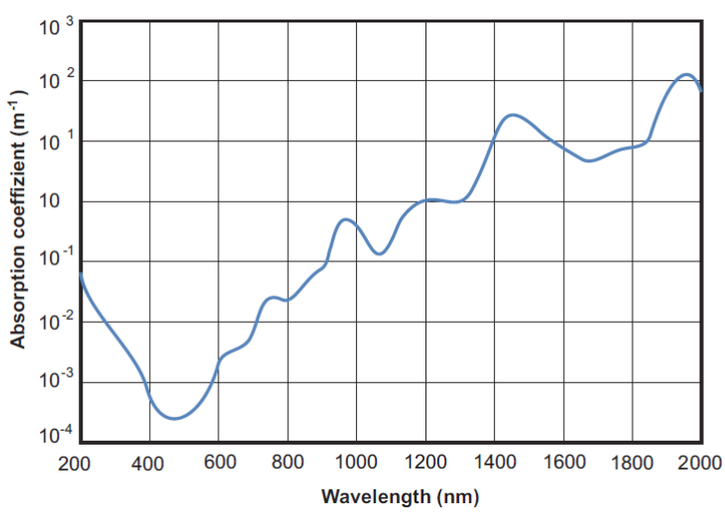


Fig. 19

Absorption coefficient in water

The use of the QuadroStar+ 980 with a 980 nm diode wavelength results in a more efficient heating of the adipose tissue and the dermis after tumescence (Fig. 20).

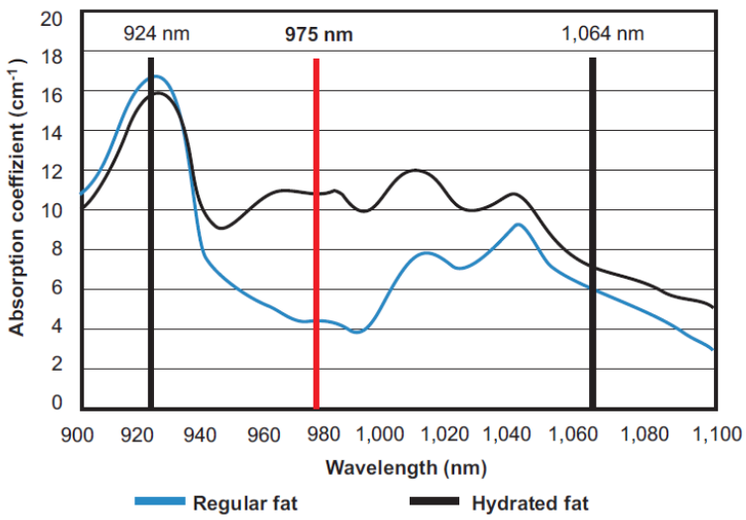


Fig. 20

Absorption coefficient of fat under physiological conditions and hydrated conditions (with tumescence)

Clinical experience and previous studies have shown that proper heating of the dermis provides additional skin retraction. In principle, as the adipose connective tissue also contains collagen heating of the septa together with reduced mechanical trauma to the tissue helps to preserve and tighten the adipose connective tissue leading to further skin retraction. Fairly immediate skin smoothing is observed while over time the skin retraction becomes even more pronounced as the septa and meshwork separating adipocytes are replaced with new connective tissue to remodel skin and body contours.

Conclusion

The study demonstrates that the removal of fat with simultaneous tissue contraction due to collagen fragmentation and inflammatory response can be safely performed in all body areas using the new QuadroStar+ 980 diode laser. (Asclepion Laser Technologies, Jena, Germany).

Studies Book

- QuadroStarPRO -

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