

A Retrospective Study on Efficacy of Pulsed Dye Laser and Intense Pulsed Light for the Treatment of Facial Telangiectasia

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ABSTRACT

Both pulsed dye laser (PDL) and intense pulsed light (IPL) systems have been demonstrated to be effective for treatment of facial telangiectasia, however there have been very few comparative studies between both treatments involving purely Asian patient populations. In this study, we performed a retrospective analysis to compare the efficacy of PDL and IPL systems for the treatment of facial telangiectasia. A total of 416 patients with facial telangiectasia who were treated by PDL or IPLs in our department from August 2012 to March 2015 were included in this study. The subjects received one of the following five treatments: PDL 595 nm (9-12 J/cm²), MaxG (500-670 nm & 870-1200 nm, 30-46 J/cm²), IPL (560-1200 nm, 18-24 J/cm²), M22 560 (560-1200 nm, 15-18 J/cm²), and M22 590 (590-1200 nm, 15-20 J/cm²). Each treatment had two sessions with 6-week intervals. The improvement percentage score in facial telangiectasia after the final treatment was evaluated by two non-treating physicians. We found almost all patients (>95.00%) had marked improvements or nearly complete clearance of the lesions after PDL 595 nm or MaxG treatment, as compared to 41.38%-56.58% patients in the other three groups that showed similar degrees of improvements. Both PDL 595 nm (9-12 J/cm²) and MaxG (500-670 nm & 870-1200 nm, 30-46 J/cm²) treatments resulted in significantly superior vessel clearance than the IPL systems with other wavelength bands (560-1200 nm or 590-1200 nm) and relatively lower fluence (15-24 J/cm²). Our results also suggested fluence levels account for the significant differences in the effectiveness delivered by different IPL systems. We concluded that PDL 595 nm and MaxG showed comparable clinical efficacy and both treatments resulted in most beneficial outcomes.

J Drugs Dermatol. 2017;16(11):611-615.

INTRODUCTION

Facial telangiectasias are dilated blood vessels that are located near the surface of the skin or mucous membranes. There are numerous factors that are associated with the development of facial telangiectasias, including chronic actinic damage, rosacea, autoimmune disease, topical steroids, sun or cold exposure, genetic factors, and inherited conditions.^{1,2} Facial telangiectasia is a common skin condition that occurs in tens of millions of people around the world with women being predominantly affected.^{3,4} It mainly appears on the face around the nose, cheeks, and chin with distinct small dilated blood vessels, which are cosmetically disfiguring for those patients with fair skin types.

Various treatment options have been developed for facial telangiectasias, including topical agents, systemic antibiotics, oral estrogens, cryotherapy, dermabrasion, electrosurgery, sclerotherapy, laser, and light treatments.⁵⁻⁸ Many laser and light systems filtered within the visible electromagnetic spectrum have been shown to be effective for the treatment of facial telangiectasias with minimal side effects and little or no downtime. These wavelengths include potassiumtitanyl-phosphate laser (KTP, 532 nm), pulsed dye lasers (PDL, 585 nm and 595 nm), diode laser (940 nm), and intense pulsed light systems (IPL, 500-1200 nm).^{5,7-15} In this study, we attempted to compare the

clearance efficiency of facial telangiectasias that were treated with PDL 595 nm or IPLs with various wavelength bands, namely 500-670 nm, 870-1200 nm, 560-1200 nm, and 590-1200 nm. We found that PDL 595 nm and MaxG (500-670 nm and 870-1200 nm) showed significantly better vascular clearance than other IPL wavelength bands (560-1200 nm and 590-1200 nm).

MATERIALS AND METHODS

Participants

A total of 416 patients with facial telangiectasias who were treated by PDL or IPL at our department from August 2012 to March 2015 were enrolled. A retrospective analysis of hospital records and a review on photographs were performed. Data regarding demographics, lesion types, photographs, treatment procedures, outcomes, and follow-ups were collected and analyzed.

The patients were subjected into the following five groups based on the treatments that they were received: PDL 595 nm (n=105), MaxG (500-670 nm and 870-1200 nm) (n=83), IPL (560-1200 nm) (n=76), M22 560 (560-1200 nm) (n=87), and M22 590 (590-1200 nm) (n=68). The general clinic information regarding patients' gender, age range, and duration of skin lesions prior to treatments were listed in table 1. Patients received

TABLE 1.

Demographic Characteristics of Patients in Each Treatment Group					
Treatment group	Female (n)	Male (n)	Age range (years)	Average age (years)	Lesion history (years)
MaxG	75	8	20-48	38.13±0.35	3-10
PDL 595	91	14	14-52	38.70±10.14	10-16
IPL 560	73	3	14-52	39.80±12.99	3-16
M22 560	87	0	13-52	37.80±10.99	3-16
M22 590	65	3	12-48	35.37±9.57	1-15

a series of two treatment sessions with a 6-week interval. After each treatment, the treated areas were immediately cooled with an ice bag for 15 minutes.

Interventions

Laser treatment was performed with a PDL (Vbeam perfecta, 595 nm, Candela Corporation, Wayland, MA) using 7 or 10 mm handpieces with dynamic cooling device (DCD). Three different IPL devices used in the study were: (1) MaxG (Icon MaxG, Cynosure, Inc. Wesford, MA); (2) IPL (IPL Quantum, Lumenis Limited, Yokneam, Israel); (3) M22 (M22, Lumenis Limited, Yokneam, Israel). For the M22 device, we applied two wavelength bands for the treatments: 560-1200 nm and 590-1200 nm. All the treatment handpieces of IPL devices were integrated with sapphire ChillTip system for epidermal cooling. The specific PDL and IPL settings regarding wavelength or wavelength bands, pulse duration, spot size, fluence level, and overlap area among spot were listed in Table 2. Three physicians performed all PDL and IPL treatments.

Efficacy Assessment

Clinical efficacy was evaluated by two independent and blinded non-treating physicians from patients' photographs based on the degree of improvement in facial telangiectasias at 2 months after the second treatment. The side effect profile (pain,

erythema, crusting, swelling, blistering) was also assessed immediately after each treatment and at one week after each treatment. We used the 1-10 scale system to assess the severity of facial telangiectasias, which was reported in detail by Tierney et al previously.⁸

For each patient, the pre- and post-treatment scores for facial telangiectasias were recorded based on blinded physician photographic analysis as a score range from 1-10. The improvement score index for each patient was calculated by the following formula: improvement score index = (the pre-treatment score – the post-treatment score)/the pre-treatment score.⁸ Four categories of efficacy evaluations for vascular lesion clearance were used based on the calculated improvement percentage: category 1, no or very minimal response (<20% improvement score index); category 2, fair improvement (20–40% improvement score index); category 3, marked improvement (40–70% improvement score index); and category 4, nearly clear (>70% improvement score index).

One-way ANOVA was used to test the differences in improvement score indexes among groups after various treatments. Paired t-test was used for comparing improvement score index for two different treatments. The data were presented as "means±s.d." and the statistical significance level was set as $P<0.05$.

RESULTS

Overall, almost all patients (>95.00%) had good (category 3) or very good improvements (category 4) after MaxG or PDL 595 nm laser treatment, as compared to 41.38%-56.58% patients in the other three groups that showed the same efficacies (Table 3; Figure 1). IPL560, M22 560, and M22 590 treatments rendered fair improvements (category 2) in 27.69% to 32.18% patients, as compared to 3.61% and 3.81% in the MaxG and PDL 595 nm treatment groups (Table 3). Moreover, a substantial portion of patients, eg, 13.16%, 26.44% and 20.00%, showed no or very minimal improvements (category 1) after IPL560, M22 560 and M22 590 treatments, respectively (Table 3).

TABLE 2.

Laser/Light Systems and Their Treatment Configurations					
Laser/Light systems	Wavelength (nm)	Energy (J/cm ²)	Pulse duration (ms)	Spot size (mm ×mm)	Overlap area per spot (%)
MaxG	500-670 & 870-1200	30-46	10-20	10×15	5-10
PDL 595	595	9-12	6-10	7 or 10	10-30
IPL 560	560-1200	18-24	3.0-25-5.0	8×35	5-10
M22 560	560-1200	15-18	(4.5-5.5)-30-(4.5-5.5)	8×15	5-10
				15×35	
M22 590	590-1200	15-20	(4.5-5.5)-30-(4.5-5.5)	8×15	5-10
				15×35	

TABLE 3.**Number and Percentage of Patients in Each Improvement Category from Various Treatments**

Laser/Light Systems	Improvement Category (number of patients/percentage from total patients)			
	1	2	3	4
Max G	0/0%	3/3.61%	58/69.88%	22/26.51%
PDL 595	0/0%	4/3.81%	66/62.86%	35/33.33%
IPL 560	10/13.16%	23/30.26%	38/50.00%	5/6.58%
M22 560	23/26.44%	28/32.18%	29/33.33%	7/8.05%
M22 590	13/20.00%	18/27.69%	32/49.23%	2/3.08%

MaxG and PDL 595 nm treatments showed good improvements (category 3) in 69.88% (58 out of 83) and 62.86% (66 out of 105) patients, respectively, while only 33.33%-50.00% patients showed the same degree of percentage improvements after IPL 560, M22 560 and M22 590 treatments (Table 3). There was a statistically significant difference of improvement score indexes among the groups (ANOVA, $P=0.0350$) (Table 4). A further paired *t*-test showed both MaxG and PDL 595 had significantly better improvement score indexes as compared to the M22 590 treatment group ($P=0.0011$ and 0.0019 , respectively).

MaxG and PDL 595 nm treatments rendered an almost complete clearance of lesions (category 4) in 26.51% (22 out of 83) and 33.33% (35 out of 105) patients, respectively, while only 3.08%-8.05% patients showed the same degree of improvements in response to IPL 560, M22 560 and M22 590 (Table 3). The PDL 595 nm laser treatment showed a significantly higher improvement score index as compared to the other groups (ANOVA, $P=0.0060$) (Table 5).

Almost all patients tolerated the therapies well and the procedures were reasonably safe. Some transient side effects, such as post-inflammatory hyperpigmentation, swelling, urticarial reaction, pain, and erythema, were observed in a few patients but were resolved within days after treatments.

DISCUSSION

We found both PDL and IPL could reduce facial telangiectasias effectively after two sessions of treatment in this retrospective analysis. PDL 595 nm and MaxG (500-670 nm and 870-1200 nm) showed comparable clinical efficacies. The same conclusion was drawn previously by Tanghetti using similar PDL and IPL configurations.¹⁶ Both treatments resulted in significantly superior vessel clearance than the IPL treatments with other wavelength bands (560-1200 nm or 590-1200 nm) and relative lower fluence (15-24 J/cm²). This finding is in accordance with the results from a previous report showing that PDL renders a better therapeutic outcome for facial telangiectasias treatment than IPL.⁷ Our results showed that a MaxG treatment delivering a high fluence (30-46 J/cm²) can produce a similar effectiveness as PDL 595 nm on clearance of facial telangiectasias.

The vascular clearance by laser and light treatments is based on the concept of selective photothermolysis, which targets the endogenous chromophore haemoglobin.^{17,18} Hemoglobin has absorption peaks in the blue, green, and yellow bands (418, 542, and 577 nm) as well as a peak further out in the near-infrared portion of the spectrum (700 to 1100 nm).¹⁹ Therefore, the systems with the wavelengths including 532 nm KTP, 585 nm PDL, 595 nm PDL, 940 nm diode laser, and IPL with 500-1200 nm bands are the effective treatment options for facial telangiectasias.^{5,7-15,20} Silver et al performed the first laser treatments on facial telangiectasias by using the continuous-wave argon (488 and 514 nm), the continuous

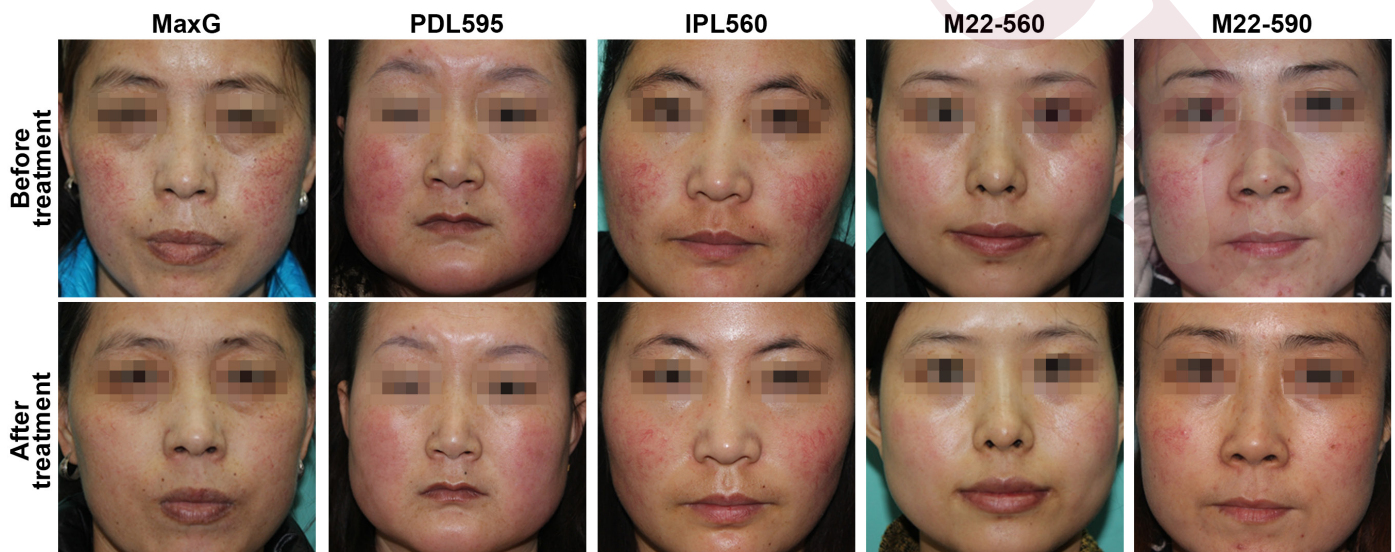
FIGURE 1. Representative photographs showing the efficacies of PDL595 and various IPLs for the treatment of facial telangiectasia.

TABLE 4.**ANOVA Analysis of Improvement Score Index Among Each Group With Marked Improvements (Category 3) After Treatment**

Lasers	MaxG (n=80)	PDL 595 (n=101)	IPL 560 (n=43)	M22 560 (n=36)	M22 590 (n=34)	F value	P value
Mean	55.38	54.103	50.724	53.1	46.401	2.7366	0.035
SD	9.2	7.904	9.036	11.406	6.097		

Data were shown as improvement score index (%).

TABLE 5.**ANOVA Analysis of Improvement Score Index Among in Each Group That Showed Very Good Improvements (Category 4) After Treatment**

Lasers	MaxG (n=22)	PDL 595 (n=35)	IPL 560 (n=5)	M22 560 (n=7)	F value	P value
Mean	77.045	92.404	82.140	79.000	5.6822	0.0060
SD	5.847	10.166	6.183	5.657		

Data were shown as improvement score index (%).

wave CO₂ (10,600 nm), and the Nd:YAG (1,064 nm) lasers.²¹ However, significant side effects of scarring and dyspigmentation were risked due to the heat spreading to adjacent tissues.²¹ The wavelength of 585 nm or 595 nm is considered most effective for treating congenital and acquired vascular lesions.¹⁹ Indeed, both wavelengths have been reported to show a noble beneficial outcome on the treatment of facial telangiectasias.^{7,12,15} In addition, many reports showed IPL systems with wavelength bands of 500-1200 nm that have a full coverage of absorption peaks of hemoglobin also showed effective for clearance of facial telangiectasias.^{5,7} However, there are very few studies comparing the efficacies of facial telangiectasias clearance between PDL and IPL.

In this study, we compared three IPL systems with four parameter settings. We found MaxG system with wavelength bands of 500-670 nm & 870-1200 nm and fluence of 30-46 J/cm² showed a superior beneficial outcome than the other IPL systems with wavelength bands of 560-1200 nm and fluence of 15-24 J/cm². Many factors may contribute to the differences in clearance of blood vessels during laser and light treatments. One factor is the pulse duration which should be close to or equal to the thermal relaxation time (TRT) of target vessels.^{17,18} A typical TRT for a variety facial vascular lesions is generally 1-10 milliseconds.²² In our study, we used the pulse durations from 3.0-30 milliseconds in all our devices, which matched to the TRT for facial telangiectasias. It has been observed that 6 and 10 milliseconds pulse durations are particularly effective with most devices when treating facial telangiectasias. Both PDL and MaxG can deliver that type of energy. There is an energy distribution shift among visible and NIR spectrum when pulse duration is changed in IPL systems, e.g. shorter pulse duration causes higher percentage of energy distributed in the shorter wavelength region.²³ Therefore, shorter pulse during dynamic spectral shifting in the MaxG system will help to distribute

more energy in the shorter wavelength region, particularly among the wavelengths of absorption peaks of hemoglobin. In addition, we also used higher energy in the MaxG than other IPL systems in this study, which also ensures adequate energy delivered in the targeted wavelength region. Interestingly, in a previous study, Nymann et al showed that PDL 595 nm showed a better outcome than the Ellipse Flex IPL system with wavelength bands from 530-750 nm and 555-950 nm with fluence of 8-20 J/cm².⁷ The authors speculated the absence of cooling during the Ellipse Flex IPL treatments might be the impact factor to the less effectiveness as compared to PDL 595 nm which is integrated with a DCD. In our study all three IPL devices have been equipped with the sapphire ChillTip cooling system in the handpieces, but showing a similar result as Nymann et al found.⁷ Therefore, epidermal cooling during treatment is unlikely the primary factor contributing to the less effectiveness of IPLs either. In our study, MaxG delivers a higher fluence level than other IPL systems and it shows a comparable effectiveness as PDL 595 nm does. Therefore, our results suggest that fluence levels account for the differences in the effectiveness delivered by different IPL systems.

Collectively, we conclude that PDL 595 nm can produce a highly beneficial outcome on the treatment of facial telangiectasias. MaxG with wavelength bands of 500-670 nm and 870-1200 nm and a fluence of 30-46 J/cm² can also be an effective treatment option of facial telangiectasias, as it renders a comparable clinical efficacy to PDL 595 nm.

DISCLOSURES

The authors have no conflicts of interest to declare.

Funding/Support: This study was supported by National Natural Scientific Foundation of China (81220108016 to GW).

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