Treatment of Facial Telangiectasia Using a Dual-Wavelength Laser System (595 and 1,064 nm): A Randomized Controlled Trial with Blinded Response Evaluation

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BACKGROUND AND OBJECTIVE Pulsed dye (PDL) 595- and 1,064-nm Nd:YAG lasers are used for the treatment of vascular lesions. PDL-heated blood exhibits increased absorption of radiation at 1,064 nm, suggesting that the use of combined sequential dual wavelengths may offer benefits over single-wavelength treatments. This study compares the treatment efficacy of combined sequential dual-wavelength versus single delivery of 595-nm PDL or 1,064-nm Nd:YAG wavelengths in facial telangiectasia in a split face study design using subpurpuric parameters.

MATERIALS AND METHODS Twenty patients were studied using the sequential delivery of PDL and Nd:YAG wavelengths on one side of the nose. The other side received either PDL or Nd:YAG treatment. Vessels (<0.6 mm in diameter) were treated with a 7-mm spot size at 10 J/cm^2, 10 ms with the PDL, followed by the Nd:YAG at 70 J/cm^2, 15 ms with a multiplex interpulse delay of 100 ms. Subjects received a single treatment, and results were evaluated after 4-week follow-up. Improvement was determined by blinded assessment of photographs taken before and after final evaluation.

RESULTS The efficacy of the dual-wavelength laser treatment when compared to Nd:YAG or PDL laser alone was significantly more evident than either single-wavelength treatment ($p<.05$). There was no statistically significant difference in efficacy between the single-wavelength treatment groups.

CONCLUSION The sequential delivery of 595- and 1,064-nm-wavelength radiation with an interpulse delay suggests that the synergistic approach to laser therapy for facial telangiectasia is a superior method compared to standard single wavelength therapy.

The authors have indicated no significant interest with commercial supporters.

The treatment of fine facial telangiectatic blood vessels is one of the most commonly requested procedures in cosmetic dermatology.

The pulsed dye laser (PDL) is presently regarded as the treatment of choice for such superficial vascular lesions. Despite demonstrated treatment efficacy[1,2] and an excellent safety profile,[3] the appearance of purpura that may persist at the treated site for up to 2 weeks has limited patient acceptance. While new longer pulse duration dye lasers have made purpura-free treatments with the PDL far more common than the treatments using purpuric settings, these have generally proved to be less effective.[4]

Black and colleagues[5–7] have suggested that multiple wavelengths used together could provide enhanced efficacy and reduced morbidity (purpura) in the treatment of vascular lesions. They pointed out the limitations of using a single wavelength where high fluences are required to achieve coagulation at the targeted blood vessel. Recently, the advent of a combined laser platform (Cynergy with Multiplex, Cynosure, Westford, MA) has allowed the 595-nm PDL and 1,064-nm Nd:YAG wavelengths to be emitted sequentially from the same handpiece.

The aim of this study was to evaluate the effectiveness of the combined sequential application of PDL and Nd:YAG wavelengths in contrast to single wave-

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lengths using subpurpuric treatment parameters in a controlled randomized split-face study design.

Material and Methods

Patients

Twenty patients were recruited between September and November 2006 in a private dermatology outpatient clinic. Patients were between 37 and 81 years old (62.4 ± 12.3 years, mean ± standard deviation). Fourteen of the patients (70.0%) were males and 6 (30.0%) were females. Inclusion and exclusion criteria for study enrollment are shown in Table 1. Patients were informed about the goals of the study, and informed consent (oral and written) was obtained from all patients. The study met the criteria of "Good Clinical Practice" and the principles of the Declaration of Helsinki as reflected in approval by the institution's human research review committee.

Treatment Modalities

Patients were randomized to receive one of four treatment regimens as shown in Table 2. All 20 patients were treated using the combined sequential application of 595-nm PDL and 1,064-nm Nd:YAG wavelengths (Cynergy with Multiplex, Cynosure) on one side of the nose. PDL irradiation was done using a fluence of 10 J/cm^2, a pulse duration of 10 ms, and a 7-mm spot size handpiece. After a multiplex interpulse delay of 100 ms, the PDL pulse was followed by the Nd:YAG laser at 70 J/cm^2 fluence of 15 ms duration. Vessels on the other side of the nose received either PDL or Nd:YAG treatment using the same device and the same parameters. Previous treatments using the device without sufficient air cooling immediately before and after treatment had caused scars in 2 of 15 cases (C. Raulin, unpublished data), so emphasis was put on meticulous pre- and posttreatment cooling of each individual treatment site using a cold air cooling device (Cryo 5, set at level 4, Zimmer Medizinsysteme GmbH, Neu-Ulm, Germany). Pulse overlap was avoided to minimize the risk of extensive thermal injury. Ice packs were used at the treated area to provide additional posttreatment cooling.

TABLE 1. Inclusion and Exclusion Criteria

Inclusion criteria:
Skin type I–III according to Fitzpatrick
Pronounced nasal alar telangiectasia with similar vessel densities on both sides
Vessel size < 0.6 mm
Exclusion criteria:
Hypersensitivity to light
Medication that is known to increase sensitivity to sunlight (e.g., tetracycline)
Medication that alters wound healing response (e.g., tretinoin)
Seizure disorders triggered by light
Pregnancy
Gold therapy
Suspicious pigmented lesions
Unprotected sun exposure within 4 weeks of treatment

TABLE 2. Patients Were Randomized to Receive One of Four Treatment Regimens as Indicated

	Dual-Wavelength Laser	
	Right Side (n = 10)	*Left Side (n = 10)*
Nd:YAG 1,064 nm	Left side ($n = 6$)	Right side ($n = 4$)
PDL 595 nm	Left side ($n = 4$)	Right side ($n = 6$)

Subjects received a single treatment, and results were evaluated at the 4-week follow-up. Treatment end point was either vessel disappearance or intravascular coagulation. In the instances where there was no vessel response, the area was retreated up to three times within the same session.

Clinical Assessment

Improvement was assessed by review of standardized photographs taken before and 4 weeks after single treatment by three experienced investigators who were not otherwise involved in the study. Before evaluating photographs, a short slide series of patients not in this study was shown as a training aid. Using this aid, consensus was reached among the

evaluators for a vessel clearance grading system. Investigators were blinded with respect to the treatment modality employed on either side of the nose. The effect was rated on a four grade rating scale as follows: Grade 1 = clearance of less than 10% of the vessels, Grade 2 = clearance of 10% to 50% of the vessels, Grade 3 = clearance of 51% to 90% of the vessels, and Grade 4 = clearance of >90% of the vessels.

If the three investigators did not agree, the mean value of the three assessments was used for evaluation. At the follow-up visit, the patients were asked about any symptoms or side effects such as post-treatment purpura, dyspigmentation, blistering, crusting, textural change, and scarring.

Statistical Data Evaluation

After completion of the study, blind was broken and the data were analyzed for differences between the treatment modalities, i.e., dual versus single wavelength and PDL versus Nd:YAG. The subjective assessment represents a rank scale rather than an interval scale because interrating differences are uneven within the scale. Therefore, the clearance rating was treated as discrete, and group differences were analyzed with the chi-square test. A possible confounding influence of age on the treatment results was evaluated with the Kruskal-Wallis test (GraphPad Prism 3.0 and GraphPad Instat 3.05, GraphPad Software, San Diego, CA). A p-value of $<.05$ was considered statistically significant.

Results

Efficacy

Overall, 8 (20.0%) of the 40 treated sites had a clearance of more than 90%, 14 (35.0%) of 51% to 90%, 10 (25.0%) of 10% to 50%, and 8 (20.0%) of less than 10%. Whereas all sites with >90% clearance had been treated with the dual-wavelength device, 7 of the 8 sites with less than 10% had received either 1,064-nm Nd:YAG or 595-nm PDL treatment alone. Eighteen of 20 sites (90.0%) had cleared by

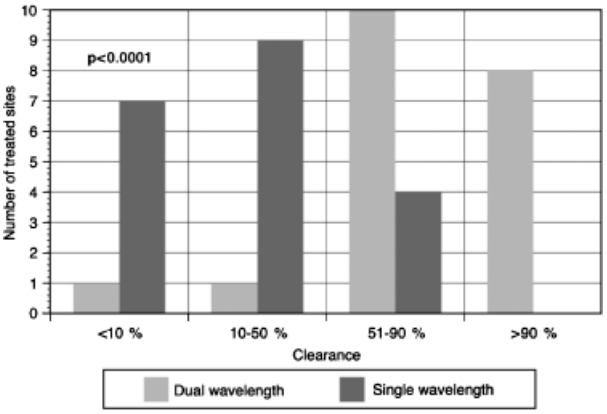


Figure 1. Clearance rating 4 weeks after dual wavelength and single wavelength treatment (1,064-nm Nd:YAG and/or 595-nm PDL).

>50% after dual-wavelength treatment compared to only 4 (20.0%) after single-wavelength laser application ($p<.0001$; Figure 1).

Among the single-wavelength treatments, PDL yielded somewhat better results than Nd:YAG treatment, but the difference was not statistically significant. Only two sites in either group achieved a clearance greater than 50% (Figure 2). The results of treatment regimens were independent of age and gender ($p>.05$; Table 3).

Safety

All treatments were well tolerated. The only adverse events related to treatment were transient purpura

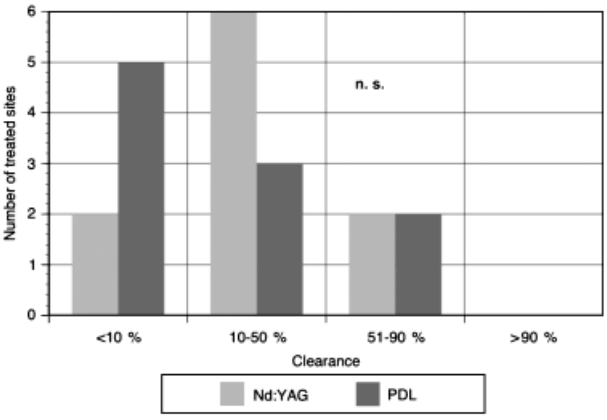


Figure 2. Clearance rating 4 weeks after single wavelength treatment (1,064-nm Nd:YAG or 595-nm PDL). n. s., not significant.

TABLE 3. Mean Age and Gender Distribution in Rating Groups after Dual- or Single-Wavelength (Nd:YAG or PDL) Treatment

	Dual Wavelength				*Single Wavelength*			
Clearance	*Count*	*Mean Age (Years)*	*SD*	*Females/Males*	*Count*	*Mean Age (Years)*	*SD*	*Females/Males*
<10%	1	48.0	NA	0/1	7	64.3	12.7	3/4
10–50%	1	67.0	NA	0/1	9	59.2	12.3	1/8
51–90%	10	57.1	11.4	3/7	4	66.3	13.2	2/2
>90%	8	70.3	10.1	3/5	0	NA	NA	0/0

NA, not applicable; SD, standard deviation.

(lasting for a few seconds only) and immediate posttreatment erythema. There was no significant between-group difference in the incidence of treatment related adverse effects.

Discussion

When careful cooling and appropriate laser settings are applied, the dual-wavelength treatment of telangiectasia provides a safe and effective treatment modality that has proven to be superior to single-wavelength treatment using either a 1,064-nm Nd:YAG or a 595-nm PDL (for example, Figure 3). The highest rate of clearance (>90%) was achieved in almost half of the sites treated with the dual-wavelength laser whereas not one site treated with either of the single wavelengths showed similar results (Figure 1). The typical outcome after dual-wavelength treatment was Grade 3 (achieved in 50% of sites), i.e., an entire rating class higher compared to single-wavelength treatment. Owing to the split-face design of the study, a bias caused by individual factors—that would otherwise have to be considered with respect to the small sample size—was minimized.

In general, PDL treatment has been shown to be highly effective for the treatment of facial telangiectasia.[8] It is, however, challenged by the continuing problem balancing efficacy against undesired side effects such as purpura. On the other hand, the avoidance of purpura meets a strong patient desire because purpura typically lasts up to 2 weeks, is cosmetically troubling, and is difficult to cover up. In the past, it has been postulated that some degree of purpura is necessary to eliminate vascular lesions effectively.[9] In the study by Ruiz-Esparza and colleagues,[10] 177 of 182 patients (97.5%) reached "good" to "excellent" results, indicating clearance rates >50% in one or two treatment sessions using purpuric parameters.[10] By comparison, published results of subpurpuric single-wavelength treatment showed rather limited success.[11–14] In a split-face study, Alam and coworkers[11] demonstrated that the side treated with purpura achieved a greater reduction in telangiectasia density in 9 of 11 cases (82%). Jasim and coworkers[13] reported a clearance of 50% or more in only 33.3% of patients after subpurpuric PDL treatment (compared with 20% in the present study). Differences in detail aside, these results are in line with the control treatment in our own study.

Typical outcomes using the 1,064-nm Nd:YAG laser include "significant" improvement in 35% to 97% of treated sites after two treatments of Nd:YAG alone and greater improvement in blue vessels.[15–17] Sarradet and colleagues,[16] for instance, treated their patients twice within 30 days (120–170 J/cm^2, 5–40 ms, 3 mm), and a "significant" improvement (category not explained) was achieved in 15% of patients after one session and in 35% after two sessions.[16] Eremia and colleagues[17] found >75% clearance in 97% of treated sites using 125 to 150 J/cm^2 and 25-ms pulse duration for small diameter vessels and 75- to 100-ms pulse durations for reticular veins.[17] All treated reticular veins

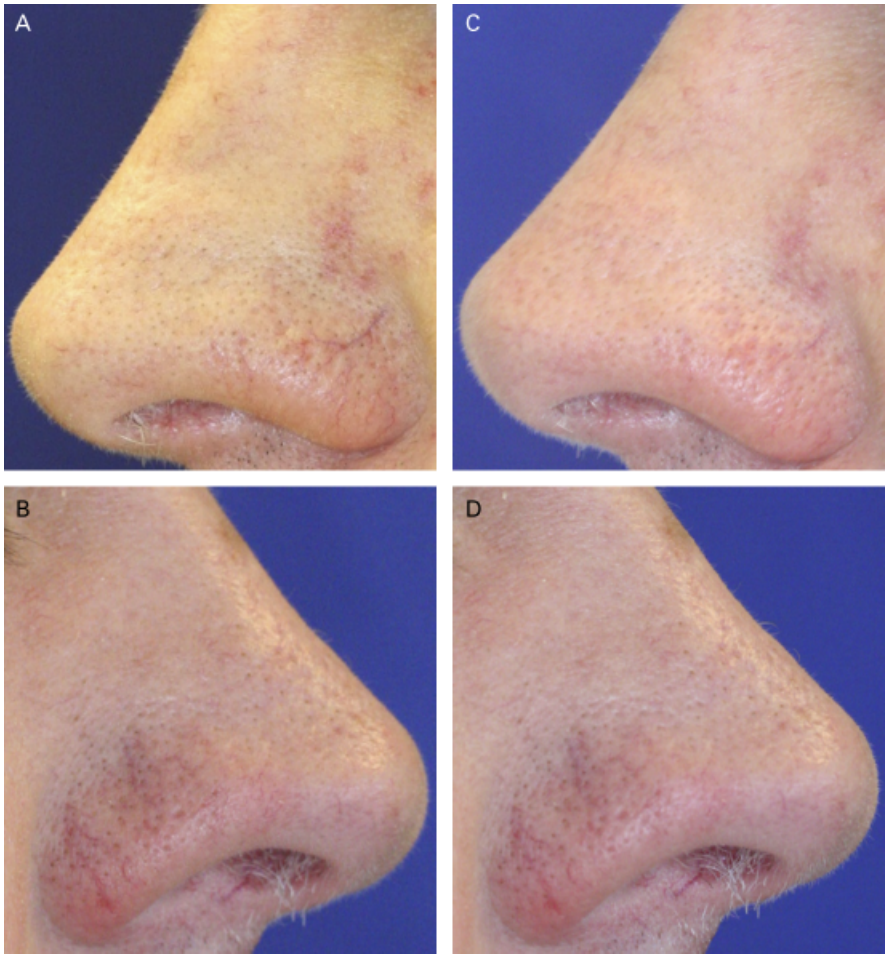


Figure 3. Nasal alar telangiectasia before (A, B) and 4 weeks following dual wavelength (C, 595-nm PDL and 1,064-nm Nd:YAG) and single wavelength (D, 595 nm) treatment. In contrast to the PDL-treated site, there is a >90% clearance following dual wavelength treatment.

including periorbital and temporal veins resolved completely after one or two passes. Although these studies have shown promising results, scarring was reported and is still not uncommonly seen at these laser settings.

An important aspect of the present study is that the results were accomplished in a single treatment session. By comparison, PDL and Nd:YAG single-wavelength treatments typically require two to three sessions to achieve similar clearance rates.[14–16] Especially with regard to side effects such as scarring, a single-treatment modality with low-energy fluences is clearly preferred.[17] Single application of 1,064 nm at efficacious levels can lead to a "runaway" increase in absorption and heating during the laser pulse, resulting in full-thickness burns due to laser treatment.[6] This in turn explains the narrow margin between efficacy and substantial side effects for single-wavelength treatment.

The present study suggests that combining 595-nm PDL and 1,064-nm Nd:YAG wavelengths for the treatment of facial telangiectasia results in a synergistic effect that facilitates a reduction in irradiance and allows effective use of subpurpuric treatment parameters. The exact nature of the synergy between Nd:YAG and PDL wavelengths remains unclear. One possible explanation is the shift in the light-absorbing properties of blood during coagulation.[18,19] Barton and coworkers[5] demonstrated that the sequential application of light at 532- and 1,064-nm

wavelength caused permanent vessel damage at radiant exposures at which the two pulses individually had little or no effect. They identified a green light–induced infrared absorption of the blood constituents and proposed the formation of met-hemoglobin (met-Hb; later spectroscopically confirmed by Randeberg and coworkers[19]) as the possible underlying mechanism. According to Tanghetti and associates,[20] the change in light-absorbing properties of the blood is a consequence of two distinct, while overlapping, mechanisms. At subpurpuric levels (i.e., operating temperatures of 65–72°C), met-Hb and other denaturized products are occurring in the liquid blood phase, whereas above purpura threshold (~80°C), a blood clot is formed, which also changes the light absorption.[20] The significance of this finding lies in the fact that both met-Hb—in contrast to all other hemoglobin species—and a clot display a high absorbance band around 1,000 nm.[21]

Hopefully further research will give us detailed information leading to even more sophisticated treatment modalities and allow us to determine the laser system and settings that will achieve optimal results in managing vascular lesions. Clinical studies utilizing the synergy of different laser wavelengths are emerging,[22,23] but clinical evidence is still inadequate because randomized controlled trials are lacking so far. To our knowledge, the present study is the first such trial, and it confirms the validity of a synergistic effect between 595- and 1,064-nm laser wavelengths when used for vessel coagulation in a typical clinical setting.

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