Comparison of the Long-Pulse Dye (590–595 nm) and KTP (532 nm) Lasers in the Treatment of Facial and Leg Telangiectasias

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BACKGROUND. *Telangiectasias develop on the face secondary to genetic predisposition, chronic actinic damage, collagen vascular disease, topical steroid application, and disorders of vascular regulation including acne rosacea. Linear and "spider" telangiectasias develop on the legs, especially in women beginning in the second to third decade, secondary to multiple factors including genetic predisposition, gravity, pregnancy, and trauma.*
OBJECTIVE. *The purpose of this investigation was to compare the 590- and 595-nm long-pulse (1.5 msec) dye laser and KTP (532 nm) laser in the treatment of facial and leg telangiectasias.*
RESULTS. *For both facial and lower extremity telangiectasias, the difference in improvement ratings between the two lasers following both one and two treatment sessions was statistically significant.*
CONCLUSION. *Both the flashlamp-pumped long-pulse dye laser and the KTP laser may play a role in the treatment of facial and leg telangiectasias. However, when used to treat vessels on the lower extremities, both of these laser systems are probably best used in conjunction with sclerotherapy of the larger "feeding" reticular veins. While long-pulse dye laser irradiation achieves superior vessel clearance, patients may prefer multiple treatments with the KTP laser due to its low side effect profile and decreased associated pain. © 1998 by the American Society for Dermatologic Surgery, Inc. Dermatol Surg 1998;24:221–226.*

The term telangiectasia refers to a dilated venule, capillary, or arteriole measuring 0.1–1.0 mm in diameter.[1] Telangiectasias develop on the face secondary to genetic predisposition, chronic actinic damage, collagen vascular disease, topical steroid application, and disorders of vascular regulation including acne rosacea. Linear and "spider" telangiectasias develop on the legs, especially in women beginning in the second to third decade, secondary to multiple factors including genetic predisposition, gravity, pregnancy, and trauma.

Traditional treatment modalities for superficial telangiectasias have included sclerotherapy, electrodesiccation, and the use of the 585-nm pulsed dye laser, which specifically targets hemoglobin. Sclerotherapy is the gold standard of treatment for lower extremity telangiectasias but may result in ulceration, scarring, hyperpigmentation, and telangiectatic matting. Facial telangiectasias are less responsive to sclerotherapy than those located on the leg and are additionally more prone to complications.[1] Electrodesiccation is generally used in the treatment of small caliber facial vessels but has the potential to produce scarring due to its nonspecific thermal effect. In addition, electrodessication often results in incomplete response or recurrence when used to treat larger caliber vessels.

Investigators have proposed that a pulsed dye laser with a longer wavelength and pulse duration than the 585-nm 450-μsec pulsed dye laser would allow for treatment of larger and deeper vessels while maintaining adequate vascular specificity.[2] Other lasers reported to be variably effective in the treatment of telangiectasias have included the argon,[3,4] Nd:YAG,[5] krypton,[6] copper vapor,[7,8] and copper bromide[9] systems. Each laser system has a unique set of advantages and disadvantages depending upon the type of lesion treated. An intense pulsed light source has also been advocated as an effective treatment modality for both facial and lower extremity telangiectasias.[10] Recently, the potassium-titanyl-phosphate (KTP) laser at 532 nm has been reported to be effective in the treatment of vascular lesions as well.[11,12] The purpose of this investigation was to compare the 590- and 595-nm long-pulse (1.5-msec) dye laser and KTP (532 nm) laser in the treatment of facial and leg telangiectasias.

Materials and Methods

Twenty female patients presenting for the treatment of either facial or leg telangiectasias were enrolled in the clinical study after informed consent had been obtained. All patients were at

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least 18 years of age (age range, 23–69 years; mean age, 40 years). The study was limited to patients with skin types I, II, and III. Only vessels less than or equal to 1 mm diameter were included in the study. All patients had at least two facial or lower extremity sites exhibiting comparable telangiectasias. All lower extremity vessels selected for treatment were proximal to the knee. Eight patients had facial telangiectasias and 12 patients had lower extremity telangiectasias.

In all patients, one of the two similarly affected areas was randomly selected for treatment with the 590- or 595-nm long-pulse (1.5 msec) dye laser (ScleroPlus Laser; Candela Corporation, Wayland, MA) and the other area received treatment with the KTP (532 nm) laser (Aura; Laserscope, San Jose, CA). For the treatment of facial vessels, the 590-nm long-pulse laser was calibrated to 15.0 J/cm^2 using a 2 × 7-mm handpiece. The KTP laser was calibrated to 15 J/cm^2 with a 10-msec pulse duration using a 1-mm handpiece at a repetition rate of two pulses per second. For the treatment of lower extremity vessels, the 595-nm long-pulse dye laser was calibrated to 20.0 J/cm^2 using a 2 × 7-mm handpiece and all treatments were performed through a transparent hydrogel wound dressing (Second Skin; Spenco Medical Corp., Waco,TX). The vessels under study were treated along their entire lengths until either the vessel was no longer apparent (KTP) or a purpuric tissue response ensued (pulse dye).

Patients were instructed to rate the pain perceived during treatment with each of the two laser systems on a scale of 1 to 10, with 1 representing minimal discomfort and 10 representing severe pain. Following laser treatment, antibiotic ointment (Bacitracin; Altaire Pharmaceuticals, Inc., Holbrook, NY) was applied to each treatment site. Photographs were taken of each treatment site before laser treatment and on four scheduled follow-up visits at 4, 8, 12, and 24 weeks using identical lighting, patient position, and camera settings (Mirror Image; Virtual Eyes, Inc., Kirkland, WA). Digital images were not manipulated in any manner. Complications including purpura, crusting, erythema, skin breakdown, hyper- or hypopigmentation, and scarring were also recorded at each follow-up visit.

At the 8-week follow-up visit, all patients were evaluated to determine whether a second laser treatment with one or both lasers was indicated. Those patients who were not retreated at 8 weeks either had achieved complete clearance of their vessels following the first treatment, had residual hyper- or hypopigmentation following the first treatment, or refused further treatment secondary to inability to tolerate the pain associated with laser treatment.

After the final follow-up visit, the photographs taken of each treatment site at baseline and at each follow-up visit were reviewed independently in a blinded manner by a physician, nurse, and by the patient. As pre- and posttreatment photographs were displayed by simultaneous projection, each assessor was asked to score the clearance of each site based on a 0 to 4 scale. Complete clearance was defined as elimination of the treated vessel. The scores represent the percentage clearance as follows: 0, <25%; 1, 25–49%; 2, 50–74%; 3, 75–94%; 4, >95%. The average scores from the physician and nurse assessors were tabulated separately from the patient's scores for each site at the 8- and 12-week follow-up visits. The final scores as represented in Figures 1 and 4 represent the mean of the scores assigned by each assessor (patient, physician, and nurse). Overall difference in ratings between the two lasers was calculated using the nonparametric Friedman's test. Differences in improvement ratings between lasers at each treatment session were calculated using the nonparametric Wilcoxon rank test.

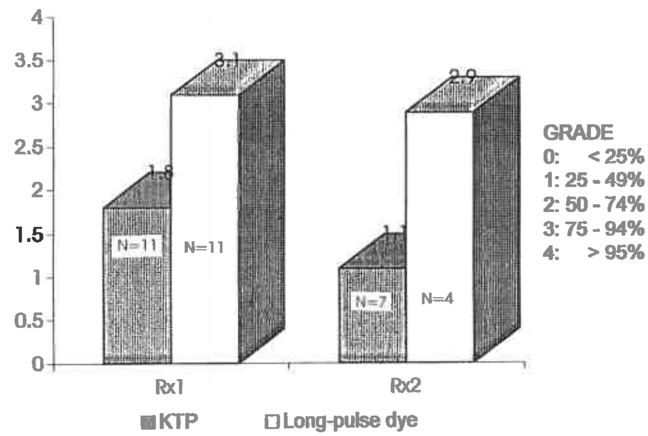


Figure 1. *Clinical improvement in lower extremity telangiectasias.*

Results

Seventeen of the 20 patients with lower extremity or facial telangiectasias returned for evaluation at all of the follow-up visits. One patient was unable to tolerate treatment of the lower extremities with either laser secondary to pain and did not return after her initial visit. Two patients with lower extremity telangiectasias were unable to attend the 8-week follow-up visit.

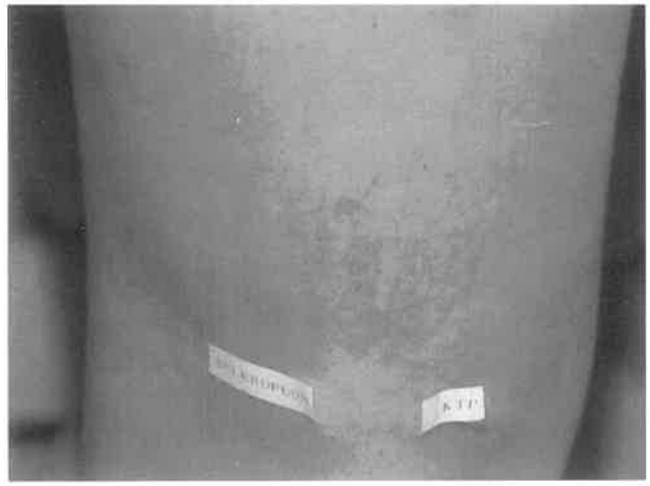
Seven of the 11 patients with leg telangiectasias received a second KTP laser treatment at week 8. Of the four patients who did not receive a second KTP laser treatment, two patients were unavailable for treatment, one was not retreated due to residual hypopigmentation at the KTP laser–irradiated site, and one patient refused a second laser treatment. Four of 11 patients with leg telangiectasias were retreated with the long-pulse dye laser at week 8. Of the remaining seven patients, five did not receive a second treatment with the long-pulse dye laser due to residual hyperpigmentation, while two exhibited residual hypopigmentation.

For both facial and lower extremity telangiectasias, the difference in improvement ratings between the two lasers following both one and two treatment sessions was statistically significant. Treatment of lower extremity vessels with the 595-nm long-pulse dye laser resulted in more significant improvement following either one or two laser treatments when compared with the same number of treatments performed with the KTP laser, as judged by both study patients and clinician assessors at week 12 ($P < 0.005$) (Figure 1). After one laser treatment for lower extremity telangiectasias, the average improvement observed 12 weeks postoperatively using the 595-nm long-pulse laser was 3.1, compared with an average improvement rating of 1.8 for the vessels treated with the KTP laser. The average improvement rating 4 weeks following two KTP laser treatment sessions was 1.1, versus an average rating of 2.9 with the long-pulse dye laser.

Average pain reported by patients during treatment of lower extremity telangiectasias with the KTP laser was 3.9, compared with 5.6 for the long-pulse dye laser. Purpura occurred in all patients undergoing long-pulse dye laser treatment of the lower extremities and resolved within 1–2 weeks following treatment. The KTP laser–treated sites, on the other hand, exhibited minimal erythema that was reported by patient to have resolved completely within hours following treatment. The treatment sites following KTP laser irradiation were described by patients as having an appearance similar to cat scratches.

Hyperpigmentation was the most commonly observed side effect of long-pulse dye laser irradiation of leg veins (Figure 2). After one treatment session, hyperpigmentation was observed in 71% (5/7) of treatment sites, with persistence at the 12-week follow-up visit. Hypopigmentation, also persisting for 12 weeks, was observed in one patient following a single laser treatment with both the long-pulse dye and KTP lasers. (Figure 3). At 24 weeks following the final laser treatment, no further clinical improvement was apparent in treated vessels compared with that noted at the 12-week evaluation; however, posttreatment hyperpigmentation had resolved in all affected patients.

Improvement was noted in all facial blood vessels treated with either laser system. All patients received a second laser treatment with both lasers at 8 weeks, with the exception of one patient who achieved complete clearance of all treated vessels following the first laser treatment session. Twelve weeks following two treatments with the long-pulse dye laser (performed at baseline and at week 8), the average improvement rating was 3.8 compared with 2.3 for those patients treated twice with the KTP laser ($P < 0.05$) (Figure 4). Average pain reported during treatment of facial telangiectasias with the KTP laser was 1.8 compared with 6.1 for the long-pulse dye laser. When used to treat facial vessels, transient purpura and hemorrhagic crusting were the most frequently reported side effects of the long-pulse dye laser (Figure 5). Subjects reported an average healing time (resolution of purpura and crusting) of 7–10 days following treatment with the long-pulse dye laser. Only one patient experienced mild hyperpigmentation at the long-pulse dye laser–treated facial site, which persisted at 4 weeks following the second laser treatment (week 12) but had resolved by 24 weeks. Facial telangiectasias treated with the KTP laser demonstrated no adverse sequelae other than transient erythema localized to the treatment sites.



A

B

Figure 2. A) Leg telangiectasias pretreatment. B) Hyperpigmentation at long-pulse dye laser site 12 weeks posttreatment.

Discussion

The role of pulsed dye lasers in the management of cutaneous vascular lesions such as port-wine stains and facial telangiectasias has been well established. The advantage of the pulsed dye laser is its ability to confine heat generated in the treated vessel to the cooling time of the vessel. However, until recently, attempts at treating lower extremity telangiectasias have been unsuccessful except in small-caliber vessels, measuring 0.2 mm or less.[13] In 1987, Polla et al treated 35 lower extremity telangiectasias with a 577-nm pulsed dye laser with a pulse duration of 360 μsec using 1-, 2-, and 3-mm spot sizes. Only 27% of treated vessels demonstrated clearing of more than 50%, while 73% demonstrated minimal response to treatment. The vessels that responded the best to treatment were fine, elevated, and erythematous.[14] The wavelength and pulse duration used in this series of patients were based on the optimal

A

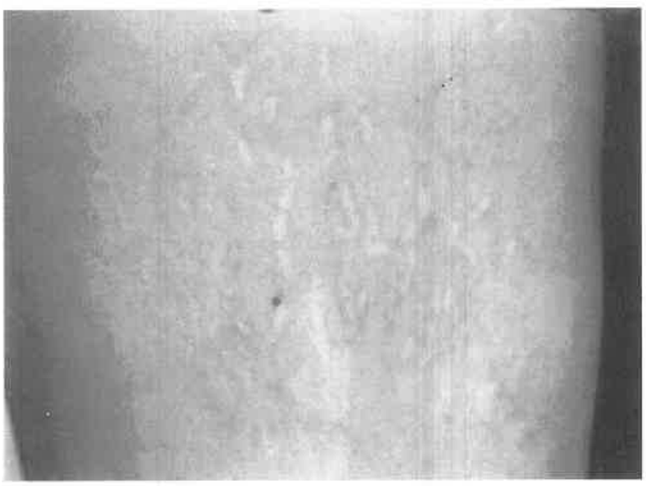


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Figure 3. *A) Leg telangiectasias pretreatment.*
B) Hypopigmentation at long-pulsed dye and KTP laser sites 12 weeks posttreatment.

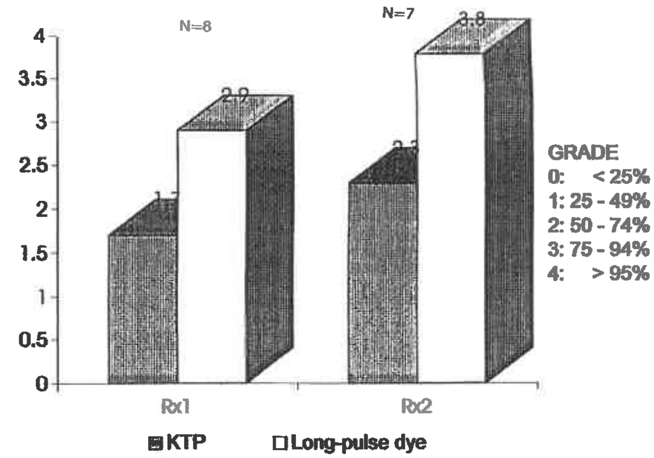

Figure 4. *Clinical improvement in facial telangiectasias.*

parameters initially established by Anderson and Parrish for the treatment of port-wine stains.[15] In 1989, Tan et al showed that the treatment of port-wine stains with a wavelength of 585 nm resulted in injury to deeper vessels without loss of vascular specificity when compared with the 577-nm wavelength.[16] While the 585-nm, 450-μsec pulsed dye laser has been shown to be effective in treating telangiectasias less than 0.2 mm in diameter, the use of short pulsed lasers for the treatment of larger leg telangiectasias has been shown to cause excessive hyperpigmentation.[17] Because wavelengths longer than 585 nm should theoretically provide even deeper dermal penetration, Hsia et al recently treated lower extremity telangiectasias in twenty patients using a 595-nm pulsed dye laser with a pulse duration of 1.5 msec through a 2 $\times$ 7 mm elliptical spot.[2] Treated vessels ranged from 0.635 to 1.067 mm in diameter. The use of an elliptical spot minimized unnecessary irradiation of surrounding tissue. Five months following one treatment session, these investigators demonstrated greater than 50% clearance in 53% of patients treated at an energy density of 15 J/cm^2 and in 64.7% of those treated at 18 J/cm^2. They noted that greater improvement in vessel clearance was observed at 5 months compared with that seen at 6 weeks, despite the fact that no additional treatments were administered. Hyperpigmentation was the most commonly observed side effect, occurring in 30.8% of treatment sites at 6 weeks follow-up, but the dyspigmentation resolved in all patients by 6 months following treatment at either fluence. Similar to sclerotherapy-induced hyperpigmentation, the hyperpigmentation observed after pulsed dye laser irradiation is likely due to extravasation of erythrocytes through the injured vessel with resultant hemosiderin deposition and perivascular inflammation leading to postinflammatory pigment changes.[13] Hypopigmentation was seen in 15.4% of the study patients at 6 weeks, but also resolved in all patients by 6 months. There was no correlation observed between skin type and incidence of transient pigmentary alterations.

Our study demonstrates that the 590–595-nm long-pulse dye laser is indeed effective not only in the treatment of facial telangiectasias, but also in the treatment of telangiectasias located on the lower extremities, which have traditionally been more difficult to treat effectively. The long pulse dye laser achieves vascular-specific thermolysis in leg telangiectasia through the optimization of laser parameters including the use of longer wavelengths, extended pulse duration, and an elliptical spot. The targeted vessel is occluded as a result of laser light generating heat within the hemoglobin-containing vessel, causing thermal injury to the vessel wall. The longer pulse duration of 1500 μsec enables delivery of laser energy to vessels over longer periods of time, resulting in gentle uniform heating or coagulation across the entire vessel, while reducing vessel rupture and its associated hyper-

A

B

Figure 5. A) Facial telangiectasias pretreatment. B) Laser-induced purpura immediately following long-pulse dye treatment on left cheek and minimal erythema on right cheek after KTP laser irradiation.

pigmentation. The parameters employed with the use of each laser system were consistent with those in general use for each of the treatment sites at the time of study initiation. Only those vessels located above the knee were chosen for treatment in order to reduce the incidence and duration of postinflammatory hyperpigmentation. In addition, hydrogel dressings were used in conjunction with long-pulse dye laser irradiation of lower extremity telangiectasia based on the previously reported high incidence of posttreatment pigmentary changes in this location. It is important, however, to warn patients about the high likelihood of prolonged hyperpigmentation prior to initiating treatment with this laser system. The observation of an overall worsening of scores following two laser treatments with the long-pulse dye laser compared with one treatment with the same laser may be explained either by a resistance of those vessels due to inherent vessel characteristics (ie, size, depth) or by the apparent clinical worsening related to postinflammatory hyperpigmention.

While somewhat less effective, the KTP laser (532 nm) may also be used to treat facial and lower extremity telangiectasias. Silver treated 47 patients with the KTP laser for vascular lesions associated with rosacea.[11] Handpieces and parameters used were variable. Thirty-eight percent of treated patients experienced at least a 70% reduction in facial vascularization following one treatment while 31.9% required two treatments to achieve the same result. The use of the KTP laser in the treatment of vessels on the lower extremities has not been reported previously. As would be expected based on its lower degree of vascular specificity, this laser resulted in more modest improvement following each treatment session when compared with the improvement observed after long-pulse dye irradiation. However, the minimal side effect profile observed following treatment makes the KTP laser particularly attractive for the treatment of facial telangiectasias. Many of the patients in this study expressed a preference for repeated treatments with the KTP laser as opposed to a single long-pulsed dye laser treatment due to its uniform association with purpura and high likelihood of hyperpigmentation.

Conclusion

Both the flashlamp-pumped long-pulse dye laser and the KTP laser may play a role in the treatment of facial and lower extremity telangiectasias. For the purposes of this investigation, vessels were not pretreated with sclerotherapy so as to minimize potential confounding variables in the assessment of results and side effects attributable to sclerotherapy versus laser treatment. However, when used to treat vessels on the lower extremities, both of these laser systems are probably best used in conjunction with sclerotherapy of the larger "feeding" reticular veins. While long-pulse dye laser irradiation achieves superior vessel clearance, patients may prefer multiple treatments with the KTP laser due to its low side effect profile and decreased associated pain.

References

1. Goldman MP, Weiss RA, Brody HJ, Coleman WP, Fitzpatrick RE. Treatment of facial telangiectasia with sclerotherapy, laser surgery, and/or electrodessication: a review. J Dermatol Surg Oncol 1993;19:899–906.
2. Hsia J, Lowery JA, Zelickson B. Treatment of leg telangiectasia using a long-pulse dye laser at 595 nm. Lasers Surg Med 1997; 20:1–5.
3. Chess C, Chess Q. Cool laser optics treatment of large telangiectasia of the lower extremites. J Dermatol Surg Oncol 1993; 19:74–80.
4. Broska P, Martinho E, Goodman MM. Comparison of the argon tunable dye lasaer with the flashlamp pulsed dye laser in treat-

ment of facial telangiectasia. J Dermatol Surg Oncol 1994;20: 749–53.

5. Goldberg DJ, Marcus JM. The use of the frequency-doubled Q-switched Nd:YAG laser in the treatment of small cutaneous vascular lesion. Dermatol Surg 1996;22:841–4.
6. Thibault PK. A patient's questionnaire evaluation of krypton laser treatment of facial telangiectases: a comparison with the copper vapor laser. Dermatol Surg 1997;23:37–41.
7. Thibault PK. Copper vapor laser and microsclerotherapy of facial telangiectasias: a patient questionnaire. J Dermatol Surg Oncol 1994;20:48–54.
8. Waner M, Dinehart SM, Wilson MB, Flock ST. A comparison of copper vapor and flashlamp pumped dye lasers in the treatment of facial telangiectasia. J Dermatol Surg Oncol 1993;19:992–8.
9. McCoy S, Hanna M, Anderson P, McLennan G, et al. An evaluation of the copper-bromide laser for treating telangiectasia. Dermatol Surg 1996;22:551–7.
10. Goldman MP, Eckhouse S. Photothermal sclerosis of leg veins. Dermatol Surg 1996;22:323–30.
11. Silver BE, Livshots YL. Preliminary experience with the KTP/532 nm laser in the treatment of facial telangiectasia. Cosmet Dermatol 1996;9:61–4.
12. Hevia O. New laser treatment for facial telangiectasias: a randomized study. Cosmet Dermatol 1997;10:53–6.
13. Goldman MP, Fitzpatrick RE. Pulsed dye laser treatment of leg telangiectasia: with and without simultaneous sclerotherapy. J Dermatol Surg Oncol 1990;16:338–44.
14. Polla LL, Tan OT, Garden JM, Parrish JA. Tunable pulsed dye laser for the treatment of benign cutaneous vascular ectasia. Dermatologica 1987;174:11–7.
15. Anderson RR, Parrish JA. Selective photothermolysis: precise microsurgery by selective absorption of pulsed radiation. Science 1983;220:524–7.
16. Tan OT, Murray S, Kurban AK. Action spectrum of vascular specific injury using pulsed radiation. J Invest Dermatol 1989;92: 868–71.
17. Alster TS. Manual of Cutaneous Laser Techniques. Philadelphia: Lippincott-Raven Publishers, 1997:143.