Laser Treatment With a 1064-nm Laser for Lower Extremity Class I–III Veins Employing Variable Spots and Pulse Width Parameters

NEIL S. SADICK, MD, FACP, FAACS

Department of Dermatology, Weill Medical College of Cornell University, New York, New York

BACKGROUND. The long-pulsed 1064-nm Nd:YAG laser (employing varying spot sizes, pulse widths, and fluences) has gained popularity for treating lower extremity blue and red vessels that are less than 4 mm in diameter.

OBJECTIVE. To evaluate the efficacy of high-power 50-ms 1064 Nd:YAG laser in the treatment of class I–III lower extremity vessels.

METHODS. Ten female patients (mean age of 39 years) had a 5-cm^2 area of veins measuring 0.2 to 3 mm in diameter treated with up to three treatment sessions using a new 1064 Nd:YAG laser, with the end point being 100% vessel clearing after three treatments. Red vessels were treated with a spot size of 1.5 mm, a fluence of 400 to 600 J/cm^2, a pulse width of 30 to 50 ms; blue vessels of 1 to 3 mm were treated with a spot size of 3 mm, a fluence of 250 to 370 J/cm^2, and a pulse width of 50 to 60 ms. Macrophotographic imaging evaluations by blinded observers using a quartile scale and a patient satisfaction scale were employed to evaluate results.

RESULTS. At month 3 after the final treatment session, 20% of all vessel types had 50% to 75% improvement. Equal clearing was noted for blue and red vessels. At month 6, 80% of patients had a greater than 75% clearing. Ninety percent of patients were highly satisfied with the treatment results at 6 months.

CONCLUSION. By varying spot size, fluence, and pulse duration, a long-wavelength 1064-nm Nd:YAG laser can achieve excellent results for treating both blue and red lower extremity vessels that are less than 3 mm in diameter.

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AN INCREASING number of individuals are seeking treatment of lower extremity veins for both medical symptomatic as well as cosmetic concerns. For the management of smaller diameter class I telangiectasias and class II/III (red veins that are less than 1 mm) venulectasias and reticular veins (blue veins that are less than 4 mm), lasers have been found to play an increasing role with the advent of the long-pulsed 1064-nm Nd:YAG laser with varying pulse width, spot size diameters, and capability for the deliverance of high-energy fluences. With the advent of the advances, more efficient panendothelial destruction of larger diameter vessels situated deeper in the dermis has become a reality.[1,2]

The purpose of this study was to evaluate the efficacy of a new high-power 50-ms, 1064 Nd:YAG laser in the treatment of class I–III telangiectasias, venulectasias, and reticular veins employing varying spot sizes, pulse durations, and fluences.

Methods

Subjects

Ten untanned female volunteers between 26 and 57 years of age (mean age of 39 years) were studied. Fitzpatrick skin types ranged from type I to IV (type I, two patients; type II, four patients; type III, three patients; and type IV, one patient).

Exclusion criteria included age of less than 18 years, pregnancy, scarring or infection in the treatment zones, sun tan, use of iron supplements or an anticoagulant, a history of photosensitivity disorder, keloid/hypertrophic scarring, or Herpes simplex in the treatment area. None of the patients had previous treatment with sclerotherapy or laser therapy.

Patients were evaluated for underlying reflux by Duplex ultrasound evaluation (Biosound Esoate–Modulo DSM-1, Indianapolis, IN). The prospective controlled study was conducted in a private practice setting.

Laser Treatment

A 5-cm^2 grid of class I–III veins measuring 0.2 to 3 mm in diameter was treated using up to three treatment

Address correspondence and reprint requests to: Neil S. Sadick, MD, 772 Park Avenue, New York, NY 10021.

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sessions with the targeted endpoint being 100% vessel clearing with the Laserscope Lyra (Laserscope, San Jose, CA). Patients were treated at monthly intervals. The vessels were located on the inner and outer thighs. All treatment sites were outlined with indelible marker, with the midinguinal crease and midpatellar notch as reference points. Symmetrical matched areas on the contralateral leg served as the control. These laser parameters were employed: red vessels, less than 1 mm; spot size, 1.5 mm; fluence, 400 to 600 J/cm^2; pulse width, 30 to 50 ms; and blue vessels, 1 to 3 mm; spot size, 3 mm; fluence, 250 to 370 J/cm^2; pulse width, 50 to 60 ms. Eighteen-millimeter compression was employed during waking hours for a period of 2 weeks. Up to three treatment sessions were employed, with the endpoint being 100% total vessel clearing.

A gliding motion was used after application of a thin coat of cooling gel. Each treatment spot was precooled and then postcooled for several seconds using the contact handpiece (4°C). The technique of repetitive single pulses was applied to each vein employment both before and after cooling.

Evaluation

Macrophotographic digital imaging was carried out using the Sony Mavica FD1 (Sony, Tokyo, Japan) immediately after treatment and at months 1, 3, and 6 after treatment.

Percentage clearing and side effects, including thrombus formations, erythema, matting, crusting, hyperpigmentation, and bruising, were determined by two nontreating blinded physicians comparing macrophotographic digital images. The response to treatment was rated on a quartile system: 0 = no clearing, 1 = 10% to 25% clearing, 2 = 26% to 50% clearing, 3 = 51% to 75% clearing, and 4 = 76% to 100% clearing. In addition, a patient satisfaction score (A = not satisfied, B = somewhat satisfied, and C = highly satisfied) was recorded by a posttreatment questionnaire.

Immediate response was assessed by the treating physician, with vessel contraction and immediate pigment darkening being the chosen end points of treatment.

Results

At month 3 after the final or third treatment session, 20% of the patients had a 50% to 75% improvement of vessel clearing. Both red and blue vessels appeared to respond equally (Table 1). At month 6, 80% of the patients had greater than a 75% improvement of vessel clearing (Figure 1 and Table 2).

A mean of 2.5 treatment sessions was employed throughout the study, with five patients achieving 100% clearing in less than the maximum three

Table 1. Results at 1 Month After Laser Treatment

Rating	*Number of Patients (N = 10)*
None	1
0% to 25%	7
26% to 50%	2
51% to 75%	0
76% to 100%	0

Table 2. Results at 3 Months After Laser Treatment

Rating	*Number of Patients (N = 10)*
None	0
0% to 25%	0
26% to 50%	1
51% to 75%	1
76% to 100%	8

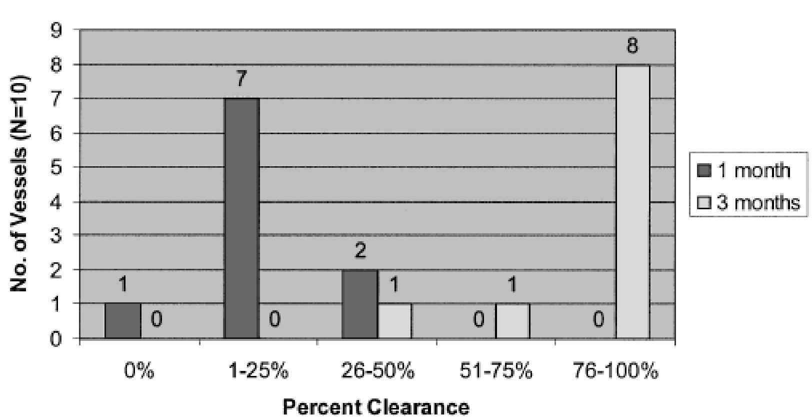

Figure 1. Percentage clearance at months 1 and 3 after 1064 Nd:YAG treatment of Class I–III veins (N = 10).

Table 3. Patient Satisfaction With 1064 Nd:YAG Laser Treatment

Rating	*Patient Number (N = 10)*
A, not satisfied	0
B, somewhat satisfied	1
C, highly satisfied	9

Table 4. Side Effects of Treatment

Side Effect	*Month 3*	*Month 6*
Thrombus	0	0
Telangiectatic matting	0	1
Blistering/crusting	1	0
Hyperpigmentation	2	0
Bruising	2	0

sessions.[2] Ninety percent of patients claimed to be highly satisfied with the treatment results of 6 months (Table 3).

The major side effects in terms of treatment were hyperpigmentation in 20% (two patients), bruising in 20% (two patients), superficial focal blistering and crusting in 10% (one patient), and telangiectatic matting in 10% (one patient). Pigmentation and crusting resolved in all cases without therapy when examined at month 6 (Table 4).

Moderate treatment discomfort was a universal patient complaint, although tolerated by all patients. Newer topical anesthetics are being studied in this regard. A patient treated in this study is shown in Figure 2.

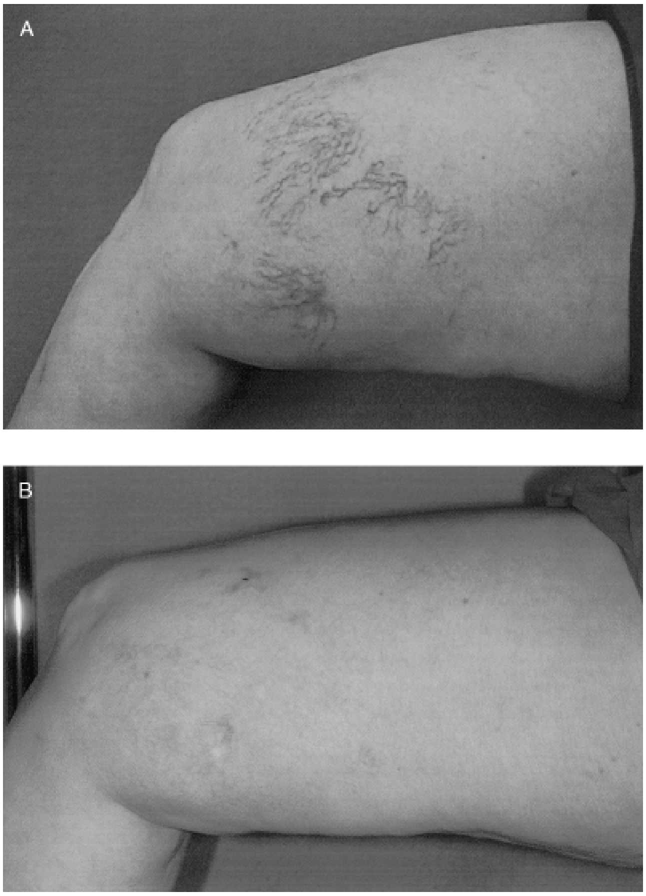

Figure 2. (a) Before Laserscope Lyra. (b) After Laserscope Lyra at 6 months posttreatment/3 treatments (3 months after last treatment session), more than 75% improvement. Settings were as follows: red vessels: spot size 1.5 mm, fluence 500 J/cm^2, pulse width 40 ms; nad blue vessels: spot size 3 mm, fluence 310 J/cm^2, pulse width 55 ms.

Table 5. Monomodal Approach to Treatment of Lower Extremity Vessels Employing the 1064 nm Nd:YAG Laser

Pulse	*Spot Size*	*Fluence*	*Duration*
Vessels less than 1 mm (red)	Small	High	Short
Vessels 1 to 3 mm (blue)	Large	Moderate	Long

Discussion

Previous studies, including that reported by the author, have advocated a bimodal approach to the treatment of leg veins where shorter wavelengths (500 to 600 nm) are used to treat class I oxygenated reddish telangiectasia and longer wavelengths (800 to 1,100 nm) are used to treat class II–III deoxygenated blue venule ectasia and reticular veins with over 75% improvement in the management of blue and red vessels less than 4 mm in diameter (Table 3).[3,4]

However, this approach requires the use of two lasers or a laser plus an intense pulsed light system in order to achieve the desired effects. The search subsequently evolved for a monomodal wavelength technology, which would address the varying size, depth, and endothelial integrity associated with lower extremity vessels.

In this regard, clinical appearance has (Table 5) taught the laser surgeon that for small red vessels that are less than 1 mm, which are usually superficial red and have a high oxyhemoglobin saturation, small spot sizes of less than 2 mm, high fluences (350 to 600 J/cm^2), and short pulse durations of 15 to 30 ms are most effective.[5–8]

For larger blue vessels that are 1 to 4 mm, which are deeper and have a lower oxygenated hemoglobin content and larger spot sizes (2 to 8 mm), moderate fluences of 100 to 350 J/cm^2 and more extended pulse durations of 30 to 50 ms are most efficacious in this clinical setting.[9–12]

Previous studies by the author have demonstrated that immediate intravascular hemorrhage followed by thrombus and upregulation of cytokines, including heat shock protein 70 and transforming growth factor-βI and transforming growth factor-βII, is noted after 1064 Nd:YAG treatment of lower extremity vessels.[13]

In this study, of note is the increased improvement of vessel clearing noted from months 3 through 6 despite no further treatment interventions. This may be related to continued vascular disruption and endothelial denaturation noted for this extended period.

The limitation of this study involves the small number of patients treated; however, comparable results were found to previous studies employing the 1064-nm Nd:YAG technology for treatment of blue venulectasias and reticular veins or the application of dual-wavelength technologies when treating red vessels that are less than 1 mm in diameter as well as larger bluish veins that are up to 4 mm in diameter.[2,4,13,14]

The approach presented here was associated with a high degree of patient satisfaction, much greater than that achieved in the past with monomodal short-wavelength technologies employing low fluence and constant beam diameter attempting to treat all sizes and colors of leg vessels.

Conclusions

By varying spot size, fluence, and pulse duration, a long-wavelength 1064-nm Nd:YAG laser can achieve excellent results for treating both blue and red lower extremity vessels that are less than 3 mm, thus satisfying both the physician and the patient. Increased patient comfort using this technology is a future goal.

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