Translational Dermatology

Research Article | Volume 1, Issue 1-2, 2026: 27-34 | Open Access

Investigating the Effect of Various Nd:YAG Laser Settings in the Treatment of Varicose Veins of the Lower Extremities

Seyed Naser Emadi[1,2,3,4], Hamidreza Mahmoudi[1,2], Ali Sadeghi Nia[1,2], Faezeh Khorasanizadeh[5], Ehsan Rostami[1,2*], Masoud Amiri[6]

[1] *Department of Dermatology, Razi Hospital, Tehran University of Medical Sciences, Tehran, Iran.*
[2] *Autoimmune Bullous Diseases Research Center, Razi Hospital, Tehran University of Medical Sciences, Tehran, Iran.*
[3] *Department of Dermatology, Imam Khomeini Hospital, Tehran University of Medical Sciences, Tehran, Iran.*
[4] *Research Center for War-affected People, Tehran University of Medical Sciences, Tehran, Iran.*
[5] *Department of Radiology, Razi Hospital, School of Medicine, Tehran University of Medical Sciences, Tehran, Iran.*
[6] *Department of Diseases, Vice-Chancellor of Health, Shahrekord University of Medical Sciences, Shahrekord, Iran.*

Article info:
Received: 18 April 2026
Revised: 12 July 2026
Accepted: 20 July 2026

* **Corresponding Author:**

Ehsan Rostami;
Department of Dermatology, Razi Hospital, Faculty of Medicine, Tehran University of Medical Sciences, Tehran, Iran.
Email: esirost65@yahoo.com

ABSTRACT

Background: Varicose veins are among the common skin problems. This study aimed to evaluate different settings for the treatment of varicose veins of the lower limb with Nd:YAG laser.

Methods: The current study was a double-blind clinical trial. Thirty-seven patients with varicose veins <3 mm in size underwent 2 sessions of Nd:YAG laser treatment with a two-month interval. Follow-up of the patients was done at 2 and 4 months after the first laser session.

Results: A significant change in response to treatment was observed after the second laser session compared to the first laser session ($p < 0.001$). After the first laser session, the recovery rate was above 50% for only 4 patients (11.1%), but after the second laser session, 18 participants experienced above 50% clinical improvement. The response rate in the group of patients who had no family history was higher than in other patients. A significant relationship was observed between the response to treatment after the second session of laser and the size of the lesion ($p < 0.002$). Moreover, a significant relationship was seen between the response rate to treatment with lasers of different fluences both after the first session and after the second laser session ($p < 0.05$).

Conclusion: Although sclerotherapy is still the gold standard for the treatment of vascular lesions of the lower limbs, the most modern treatment method is the use of Nd:YAG laser, especially in patients with lighter and thinner skin and patients with injection phobia.

Keywords: Varicose Veins, Energy, Nd:YAG Laser, Pulse Duration

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Citation: Emadi SN, Mahmoudi H, Sadeghi Nia A, Khorasanizadeh F, Rostami E, Amiri M. Investigating the Effect of Various Nd:YAG Laser Settings in the Treatment of Varicose Veins of the Lower Extremities. Transl Dermatol. 2026;1(1-2):27-34.

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Introduction

Varicose veins, a prevalent vascular condition marked by venous insufficiency and reflux, considerably impact the quality of life for millions, particularly in the lower limbs. This ailment is linked to a significant degree of morbidity, which includes chronic pain, swelling, alterations in skin pigmentation, and the risk of serious complications such as venous ulcers and thromboembolic incidents [1]. In the last twenty years, minimally invasive therapies have become the preferred choice for treating varicose veins, providing benefits over conventional surgical techniques regarding effectiveness, safety, and patient satisfaction [2]. Among the different minimally invasive methods, sclerosing foam therapy and laser treatment have gained significant acceptance. Laser therapy is a desirable alternative method in patients with needle phobia and side effects of sclerotherapy such as neovascularization, and in cases of allergy to sclerosing substances [3]. The most basic lasers to treat vascular lesions were continuous wave argon (488 nm and 514 nm), continuous wave carbon dioxide (10,600 nm), and Nd:YAG (1,064 nm). This wavelength of Nd:YAG laser is not absorbed by hemoglobin, but instead, it has the possibility of penetrating and absorbing in deeper vessels [4]. Although the Nd:YAG laser gives a dramatic immediate response, in the long term, it has been proven that contrary to facial lesions, it does not have a favorable response for venous lesions of the lower limbs [5]. Other applications of this laser include vascular malformations in the oral mucosa, vascular tumors originating from endothelial hyperplasia such as hemangioma, vascular malformations, and lesions due to vascular ectasia such as telangiectasia of small vessels and varicose veins, venous lake, and small pyogenic granulomas [6]. The maximum size of leg varicose veins which are treatable with Nd:YAG laser is up to 3 mm. This laser continuously emits infrared light with a wavelength of 1,064 nm and penetrates the tissue to a depth of 4-5 mm. It also has the ability of photothermal coagulation of deep large vessels in the mid-dermis [6,7]. The longer the laser pulse duration is, the more uniform and slower its vascular penetration and effect is, and as a result, the possibility of purpura and subsequent hyperpigmentation is low [8].

Materials and Methods

This study was a double-blinded randomized clinical trial conducted on 37 patients referred to the laser clinic of Razi Hospital from December 2022 to March 2023. The study protocol was approved by the ethics committee of Tehran University of Medical Sciences with code 1399.1073 and clinical trial code IRCT20211203053262N1.

Sample size was calculated based on previous studies considering a large effect size (DZ=0.67), a significance level of 0.05, and a test power of 95%. The calculated sample size was pre-planned to be 31 people, but considering a 20% drop, it was planned to be 37.

Inclusion criteria: Patients with up to 5 vascular lesions <3 mm above the knee and up to 5 vascular lesions <3 mm below the knee were included in the study.

Exclusion criteria: Having a history of arterial and venous thrombosis, involvement of perforating and deep vessels on ultrasound, having an active infection in the laser area, having a vascular lesion only on one side of the knee, having a history of laser or sclerotherapy in the last 6 months, having a history of liver cirrhosis or taking OCP, pregnancy and breastfeeding, skin types 5 and 6, and a history of sunburn.

The data collection tool was a questionnaire that included individual questionnaires about demographic information, satisfaction with treatment, photography of vascular lesions, and clinical examinations about laser effectiveness and laser complications. After the approval of the ethics committee and obtaining the informed consent form from the patients, they were sent for Doppler ultrasound evaluation. If the sonography was normal, a baseline photo was taken of the marked lesions. At months 0 and 2, Nd:YAG laser treatment (wavelength 1,064 nm, spot size 3×10) was performed by computer-generated randomization (random number generation) with 2 protocols. If both lower limbs were involved, one limb was randomly lasered with energy of 160-180 J and pulse duration of 50 msec, and the other with energy of 120-140 J and pulse duration of 10 msec. However, if only one leg was involved, based on the medial and lateral aspects of that leg, the above-mentioned energy and pulse duration were applied randomly. At the 2nd and 4th months after the first laser session, the patients had a follow-up and photo review session. During the follow-up period, the degree of recovery of lesions and complications was tracked and recorded. The doctor's examination in terms of size and color and the degree of recovery was done according to the following scale: 0: no improvement, 1: <25% improvement, 2: 25-50% improvement, 3: 50-75% improvement, 4: >75% improvement. The level of patient satisfaction was measured according to the following scale: (-3: severe worsening of lesions, -2: moderate worsening of lesions, -1: slight worsening of lesions), (0: no change, 1: partial improvement, 2: moderate improvement, 3: great improvement). The patient's pain level during the first and second laser sessions was measured on the following scale from 0 to 10: (0: no pain, 10: the most pain the patient has experienced). Side effects after

laser (PIH [hypo- or hyperpigmentation], atrophy, infection, ecchymosis, bleeding, nerve damage) were also recorded.

After collecting the data, the information was entered into SPSS software and was analyzed using the chi-square test and other statistical tests.

Result

In this study, more participants were initially enrolled than the minimum calculated sample size. (70 people). However, 32 patients out of 70 were excluded from the study: 9 people stopped doing the second laser session because they could not tolerate the pain during the laser; 8 patients turned to sclerotherapy and surgical procedures due to dissatisfaction with the first laser session; Seven participants developed COVID-19 during the study period. 3 people got pregnant; 2 people got severe burns at the laser site; 2 people migrated abroad; and 1 patient did not complete the laser treatment due to his wife's lack of consent. There were no deaths or major complications such as deep vein thrombosis or ischemia during or after the laser. Thirty-seven patients, including 29 women (78%) and 8 men (22%), completed the study. The youngest participant was 26 years old and the oldest was 59 years old. The age range of the participants was 30-40 years.

The rate of response to treatment after the first and second laser sessions is reported in Table 1. A significant change in the response rate to treatment was observed over time ($p < 0.001$). Although the recovery rate above 50% after the first laser session was only 11.1% (4 people), after the second laser session this rate was 50% (18 people).

There was no significant relationship between the results of the treatment in the first and second sessions regarding the age of the patients (P value>0/05).

According to the results of Table 3, there was no significant relationship between the gender of the patients and the result of the treatment in the first session (P value>0/6).

The results of Table 4 showed that there was no significant relationship between the rate of response to treatment and skin type ($p > 0.3$).

According to Table 5, a significant relationship was observed in response rate after the second session (but not the first one) regarding positive family history of varicose veins ($p < 0.04$; effect size = 0.333, moderate).

According to Table 6, there was no significant

Table 1. Response rate of participants after first laser session.

		Response after 2st treatment				
		0-25%	26-50%	51-75%	76-100%	Total (%)
Response after 1st treatment	0-25%	0	8	5	0	13(36.1)
	26-50%	0	8	7	4	19(52.8)
	51-75%	0	2	1	1	4(11.1)
	76-100%	0	0	0	0	0
	Total (%)	0	18(50)	13(36.1)	5(13.9)	36

Table 2. Response rate regarding age.

		Response after 1st treatment			
		0-25%	26-50%	51-75%	76-100%
Age	0-20	0	0	0	0
	21-30	0	1	0	0
	31-40	8	11	1	0
	41-50	4	3	1	0
	51<	1	4	2	0
		Response after 2nd treatment			
		0-25%	26-50%	51-75%	76-100%
Age	0-20	0	0	0	0
	21-30	0	0	0	1
	31-40	0	11	7	2
	41-50	0	3	4	1
	51<	0	4	2	1

Table 3. Response rate regarding gender.

		Response after 1st treatment			P-value
		26-50%	51-75%	76-100%	
gender	Male	5	2	0	0.606
	Female	13	11	5	
		Response after 2nd treatment			
gender		26-50%	51-75%	76-100%	
	Male	5	2	0	0.166
	Female	13	11	5	

Table 4. Response rate regarding skin type.

		Skin Type		
		2	3	4
Response after 1st treatment	0-25%	2	4	7
	26-50%	4	8	7
	51-75%	1	0	3
		Skin Type		
		2	3	4
Response after 2nd treatment	26-50%	5	3	10
	51-75%	2	6	5
	76-100%	0	3	2

Table 5. Response rate according to family history.

		Response after 1st treatment		
		0-25%	26-50%	51-75%
Family History	Positive	8	11	3
	Negative	5	8	1
		Response after 2nd treatment		
		26-50%	51-75%	76-100%
Family History	Positive	14	6	2
	Negative	4	7	3

Table 6. Response rate regarding size.

		Response after 1st treatment		
		0-25%	26-50%	51-75%
Size	2mm>	4	7	1
	2-3mm	9	12	3
		Response after 2nd treatment		
		26-50%	51-75%	76-100%
Size	2mm>	2	6	4
	2-3mm	16	7	1

relationship between the response rate to treatment after the first session and the size of the lesion ($p > 0.09$). However, a significant relationship was observed between the response to treatment after the second session and the size of the lesion ($p < 0.02$), such that patients with lesion size less than 2 mm had a significantly better response rate (large effect size = 0.5).

In examining the relationship between the location of the lesion and the response to treatment after the first session and after the second session, no significant relationship was observed (p-values: 0.57 and 0.24, respectively).

Table 9 shows the frequency distribution of patients' satisfaction by gender. Also, no significant difference was observed in the level of patients' satisfaction with patient gender ($p = 0.10$).

Table 10 shows the size frequency distribution in millimeters. Also, in investigating the relationship between the size of the lesion and the level of patient satisfaction, no significant relationship was observed ($p > 0.05$).

Table 11 shows the frequency distribution of patients' satisfaction with skin type. Also, there was no significant relationship between the level of satisfaction of the

Table 7. Response rate after first session according to location.

		Location				
		Right.Tight-Left.Leg	Right.Tight-Left.Tight	Right.Leg-Left.Leg	Right.Tight-Right-Leg	Left.Tight-Right.Leg
Response after 1st treatment	0-25%	0	7	5	1	0
	26-50%	1	7	9	0	2
	51-75%	1	3	0	0	0

Table 8. Response rate after first session according to location.

		Response after 2nd treatment		
		26-50%	51-75%	76-100%
Location	Right.Tight-Left.Leg	1	1	0
	Right.Tight-Left.Tight	7	7	3
	Right.Leg-Left.Leg	9	4	1
	Right.Tight-Right-Leg	0	1	0
	Left.Tight-Right.Leg	1	0	1

Table 9. Patient satisfaction regarding gender.

		Patients' satisfaction					P-value
		Worse	Dissatisfaction	Mild	Moderate	Good	
Gender	Male	0	2	4	1	0	0.105
	Female	1	3	11	9	5	

Table 10. Patient satisfaction regarding size.

size	Patient satisfaction	N	Percent	P-value
2mm>	Dissatisfaction	1	8.33	0.293
	Mild	3	25.00	
	Moderate	5	41.67	
	Good	3	25.00	
2-3mm	Worse	1	4.17	
	Dissatisfaction	4	16.67	
	Mild	12	50.00	
	Moderate	5	20.83	
	Good	2	8.33	

Table 11. Patient satisfaction regarding skin type.

Patient satisfaction	Skin type	N	Percent	P-value
Worse	4	1	100.00	
Dissatisfaction	2	3	60.00	
	4	2	40.00	
Mild	2	3	20.00	
	3	5	33.33	
	4	7	46.67	0.385
Moderate	2	1	10.00	
	3	5	50.00	
	4	4	40.00	
Good	3	2	40.00	
	4	3	60.00	

Table 12. Patient satisfaction regarding family history.

Family history	Patient satisfaction	N	Percent	P-value
Positive	Worse	1	4.55	
	Dissatisfaction	4	18.18	
	Mild	11	50.00	
	Moderate	3	13.64	
	Good	3	13.64	0.185
Negative	Dissatisfaction	1	7.14	
	Mild	4	28.57	
	Moderate	7	50.00	
	Good	2	14.29	

Table 13. Response rate after first session regarding laser setting.

Treatment	0-25%	25-50%	50-75%
Fluence(120_140)	21(56.76%)	16(43.24%)	0 (0.00%)
Fluence(160_180)	14(37.84%)	18(48.65%)	5(13.51%)

Table 14. Response rate after second session regarding laser setting.

Treatment	0-25%	25-50%	50-75%	>75%
120_140	4(10.81%)	19(51.35%)	13(35.14%)	1(2.7%)
160_180	2(5.41%)	17(45.95%)	12(32.43%)	6(16.22%)

patients and the skin type of the patients ($p > 0.05$).

Table 12 shows the frequency distribution of family history with the level of satisfaction with treatment. Also, there was no significant relationship between family history and patient satisfaction with treatment ($p > 0.05$).

A significant relationship between the effect of laser with fluence ranges of 120-140 and 160-180 was observed after the first and second sessions (p-values: 0.002 and 0.008, respectively).

Discussion

Anomaly of leg veins originates from reflux, the presence of inefficient valves (small and large saphenous veins), and the effect of gravity [7]. Varicose veins of the lower limbs are a common cosmetic problem that affects

about 40% of women in the United States. Although sclerotherapy is considered the main treatment, it is difficult to inject into vessels smaller than 1 millimeter. In the last 5 years, the use of vascular-specific laser with a higher wavelength and pulse has shown remarkable results similar to sclerotherapy. It has provided even better results by increasing the pulse duration and wavelength; laser penetration of the laser into the vessels of the deep layers of the dermis increases [2].

The newest vascular laser is the Nd:YAG laser, which has high energy, millisecond pulse, and wavelength in the IR range (1,064 nanometers). One of the important characteristics of this wavelength is that it lies within the near-infrared spectrum, enabling deeper tissue penetration. These features cause the laser to penetrate deeper into the skin [4]. In the study by Anila Fratila et al. regarding the effect of long-pulse Nd:YAG laser on leg vascular lesions of 22 women, above 75% improvement was seen, and this percentage was obtained after 2-3 laser sessions with intervals of 6-8 weeks. Hence, they came to the conclusion that the effect of this laser on vascular lesions of 0.3-3 mm in terms of safety and efficiency in all skin types is more important than other lasers [8]. In the study by Gabriel and colleagues on 285 patients with leg vascular lesions, 43% of patients had a recovery of more than 75% and 45% of patients had a recovery of 50-75% [9]. In our study, which was performed on 37 patients with vascular lesions less than 3 mm using the same laser after 2 sessions with an interval of 8 weeks, 36% of patients recovered 50-75% and 14% recovered more than 75%. In a study conducted by Kemal Ozyurt et al., using Nd:YAG laser with fluence of 200 J and pulse duration of 60 msec on 1-3 mm telangiectasia of the feet, after the lack of appropriate treatment response, they achieved favorable results by gradually increasing the laser fluence. Also, they found that for the treatment of these lesions, the range of laser parameters can be in the form of an interval: fluence can be from 90 to 400 J/cm², pulse duration from 10 to 100 msec, and spot size from 1 to 10 mm [7].

In the study by Rex Moulton and his colleagues, using the Nd:YAG laser on leg varicose veins, they found that pain is the limiting factor in increasing the fluence and reducing the laser pulse. As a result, they were unable to treat vascular lesions over 4 mm by laser [10]. In the study by Anwar et al., most of the patients complained of a burning sensation like a bee sting after laser, and 12 out of 15 patients were dissatisfied with the laser results. Also, most patients complained of scaling 1-2 weeks after the laser [11]. While most of the patients in our study (64%) had no complications after laser treatment, about 16% of our patients were dissatisfied with the treatment. In the study by Roman and her colleagues regarding the investigation of complications caused by Nd:YAG laser on the vessels of the lower limbs, which was conducted on 2,500 patients, it was found that 8.6% had hypopigmentation and 11.7% had hyperpigmentation [12].

In our study, 5.5% experienced hypopigmentation and 25% experienced hyperpigmentation. In Mazes et al.'s study, they found that the desired response of facial telangiectasia can be obtained with even one session of Nd:YAG laser, while 3 to 5 laser sessions are necessary to treat leg telangiectasia [13]. In several other studies regarding the efficacy of Nd:YAG laser compared to sclerotherapy on vascular lesions of the legs, it was seen that sclerotherapy responds earlier and better. As a result, sclerotherapy is the gold standard for the eradication of telangiectasia and small vascular lesions of the legs [12].

Conclusion

Although sclerotherapy is still the gold standard for the treatment of vascular lesions of the lower limbs, an acceptable method of treatment, especially in patients with lighter and thinner skin and patients with injection phobia, is the use of Nd:YAG laser. We found a significantly better response to laser therapy with lesions smaller than 2 mm. Moreover, the response to laser treatment was better in those without a family history of varicose veins. Last but not least, the response to treatment was better with higher fluences.

Conflict of interest

There was no conflict of interest between the authors in the above article.

Acknowledgments

Special thanks are given to Tehran University of Medical Sciences, Faculty of Medicine, and all colleagues at Razi Hospital for their comprehensive support.

References

[1] Landthaler M, Hohenleutner U. Laser therapy of vascular lesions. Photodermatol Photoimmunol Photomed. 2006;22(6):324-32. https://doi.org/10.1111/j.1600-0781.2006.00254.x

[2] Lanigan SW. Laser treatment of vascular lesions. In: Laser dermatology. Berlin, Heidelberg: Springer; 2013. p. 13-40. https://doi.org/10.1007/978-3-642-32006-4_2

[3] Kunishige JH, Goldberg LH, Friedman PM. Laser therapy for leg veins. Clin Dermatol. 2007;25(5):454-61. https://doi.org/10.1016/j.clindermatol.2007.05.008

[4] Goldberg DJ. Laser treatment of vascular lesions. Clin Plast Surg. 2000;27(2):173-80. https://doi.org/10.1016/S0094-1298(20)32705-X

[5] Anwar MU, Sharpe DT. Efficacy of the Nd Yag laser in the treatment of superficial cutaneous vascular lesions. Eur J Plast Surg. 2008;30(5):219-22. https://doi.org/10.1007/s00238-007-0191-1

[6] Civas E, Koç E, Aksoy B, Tutal E, Aksoy A. Clinical experience in the treatment of different vascular lesions using a neodymium-doped yttrium aluminum garnet laser. Dermatol Surg. 2009;35(12):1933-41. https://doi.org/10.1111/j.1524-4725.2009.01355.x

[7] Ozyurt K, Yetkin S, Ozyurt S, et al. Treatment of superficial cutaneous vascular lesions: experience with the long-pulsed 1064 nm Nd:Yag laser. ScientificWorldJournal. 2012;2012:197139. https://doi.org/10.1100/2012/197139

[8] Fratila AA, Schonlebe J, Hagedorn M, et al. Selective photothermolysis of spider veins and reticular varices with the long-pulsed Nd:Yag laser. Phlebologie. 2020;49(1):16-22. https://doi.org/10.1055/a-0865-5296

[9] Ianosi G, Calbureanu M, Tanase C, et al. Comparative study in leg telangiectasias treatment with Nd:Yag laser and sclerotherapy. Exp Ther Med. 2019;17(2):1106-12. https://doi.org/10.3892/etm.2018.6985

[10] Barrett RM, Kobylinska I, Derita L. The role of the Sciton Profile Nd:YAG laser in the reduction of cutaneous varicosities, a pilot study. Biomed J Sci Tech Res. 2019;19(5):14619-23. https://doi.org/10.26717/BJSTR.2019.19.003365

[11] Anwar MU, Sharpe DT. Efficacy of the Nd Yag laser in the treatment of superficial cutaneous vascular lesions. Eur J Plast Surg. 2008;30(5):219-22. https://doi.org/10.1007/s00238-007-0191-1

[12] Smucler R, Horak L, Mazanek J. Invasive leg vein treatment with 1064/1319 Nd:Yag laser: combination with dye laser treatment. In: Anderson RR, editor. Lasers in surgery: advanced characterization, therapeutics, and systems IX. Vol 3590. Bellingham (WA): SPIE; 1999. p. 110-6. https://doi.org/10.1117/12.350996

[13] Lumenis. Leg veins treatment guidelines with Long Pulse (LP) Nd:YAG.