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New 2,000 W, 1,060 nm Diode Laser with a Spot Size of 4x3 mm for Vascular Lesion Treatments

Reyna Vargas Lamas[1], Gregorio Viera Mármol[1], Gabriela Vergara Vallejo[1], Marta Castillejos Pallàs[1], José Antonio Ferrández Martínez[1], Carmen Cano Ochoa[1], Jorge Villena García[1]

[1]Clinical Department at Cocoon Medical, Barcelona, Spain

Abstract – Background*: Diode laser technology with a similar wavelength to 1,064 nm Nd:YAG solid-state lasers has been used to treat vascular lesions. This wavelength range is believed to provide the best compromise between efficacy and safety for different skin types. Diode laser technology has several advantages over solid-state lasers, such as its lower cost; smaller size; superior durability; the absence of optics, pumping lamps and crystals; minimal maintenance requirements; and its quick and easy installation. However, the main limitation is that diodes on the market cannot reach high fluences with short pulse durations.* ***Objective:*** *To present a high-power (2,000 W) 1,060 nm diode laser with a spot size of 4x3 mm, which allows for the same specifications as Nd:YAG lasers, to provide effective, comfortable and safe treatments for a wide range of facial and corporal vascular lesions such as telangiectasias, red and blue veins, cherry angiomas, fine reticular veins, venulectasias, spider veins and erythrosis.* ***Materials and methods:*** *17 subjects with vascular lesions of grade C_0 to C_1 and skin types II to V according to the Fitzpatrick scale, involving a total of 78 treatment areas and 248 procedures, were treated in a prospective study on clinical efficacy and safety using the Primelase device (Cocoon Medical, Spain). The laser parameters included: static mode with fluences between 100 and 225 J/cm^2, pulse widths between 9 and 50 ms and a frequency of 1 Hz; as well as dynamic mode with fluences between 15 and 45 J/cm^2, pulse widths between 3 and 4 ms and a frequency of 10 Hz. The number of sessions and the parameters were defined according to the lesion and its progress during the treatment.* ***Results****: The sessions were found to be quick, with a mean time of 2 minutes per area. The treatments were comfortable with a moderate pain sensation valued at 4.95 out of 10 (SD 2.45, $p < 0.01$). The endpoint reaction in the lesion was mild to moderate with a rating of 1.73 out of 3 (SD 0.66, $p < 0.01$). The overall results were rated as very good to excellent (51-100% reduction) with a mean rating of 3.48 out of 4 (SD 0.73, $p < 0.01$) on the GAIS scale. Patient satisfaction was good and excellent with a rating of 2.56 out of 3 (SD 0.68, $p < 0.01$).* ***Conclusions:*** *The new 4x3 mm 1,060 nm 2,000 W diode laser has demonstrated very good results for the elimination of a wide range of vascular lesions in facial and corporal areas, offering a comfortable, safe and fast treatment for subjects with grade C_0 to C_1 vascular lesions and skin types II to V.*

Keywords – *Vascular lesion, laser treatment, diode laser 1,064 nm, high efficacy.*

I. INTRODUCTION

Vascular lesions are currently one of the main reasons for consultations in aesthetic centres or dermatological clinics, as they have a significant impact on an aesthetic, psychological and functional level.

Depending on the reason for their manifestation, vascular lesions can be divided into two types: congenital (haemangiomas and vascular malformations) or acquired (telangiectasias, angiomas, poikiloderma of Civatte, superficial blue veins, spider veins, etc.)[1]. The CEAP classification (Clinical Etiological Anatomical Pathophysiological) serves as a basis for diagnosing and classifying them. The severity scoring system is based on 3 factors: the number of anatomic segments affected, grading of symptoms and disability. The classifications are as follows: C_0 – no visible vessels or palpable signs of vascular disease (including rosacea); C_1 – telangiectasias and reticular veins; C_2 – varicose veins, distinguished from reticular veins by a diameter of 3 mm or more; C_3 – oedema; C_4 – changes in the subcutaneous skin; C_5 – healed venous ulcer and C_6 – active venous ulcer[2]. These lesions affect subjects of all skin types. The pathophysiology of these lesions is related to the weakness of elastic fibres of the blood vessel walls resulting in persistent vasodilatation[3], although they may also be due to photoageing processes[4].

Based on Anderson and Parrish's theory of selective photothermolysis, laser-based devices have emerged as an alternative to the conventional sclerotherapy technique[5]. This theory hypothesises that some molecules (chromophores) present in the tissue being treated can selectively absorb light. In vascular lesions, the main target chromophore is oxyhaemoglobin. The absorbed energy causes photothermal damage, due to heating of the vessel, intravascular coagulation and collagen contraction. The immediately observable effects are whitening or darkening of the vessel followed by erythema or oedema. The thermal energy therefore coagulates the lesion, which is naturally eliminated by the immune system, fading away a few weeks after treatment[6].

Another blood chromophore is deoxyhaemoglobin, which has different absorption spectra than oxyhaemoglobin[8]. This explains the difference in absorption between red and blue veins, red veins being richer in oxygen and therefore absorbing more energy, while blue veins are lower in oxygen and require more fluence for the chromophore to absorb the energy.

During treatment, the number of passes over the lesion is also an important consideration as, after heating, oxyhaemoglobin is transformed into methaemoglobin, which is found to absorb 4 times more energy, so more than one pass can be used to improve the treatment[7].

Nd:YAG lasers have been widely used in the treatment of vascular lesions of less than 3 mm in size because the 1,064 nm wavelength provides a good absorption ratio between haemoglobin and melanin, a factor that facilitates the treatment of most skin types[8].

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Recently, high-power diode lasers have been considered for the treatment of vascular lesions as they have many advantages over solid-state lasers due to their lower cost, compact size and fast modulation response. In addition, they do not use pumping lamps, fibres or glass that can break, eliminating the risk of costly repairs and maintenance. Diode lasers are therefore a good option for their long useful life and cost-effective price. The installation of diode lasers is another advantage since complex electrical installations are not required as they can be used with a domestic electrical connection of 220 V and 50/60 Hz.

Some clinical studies have shown that 1,060 nm diode lasers provide good results for vascular lesions (cherry angiomas, venulectasias, telangiectasias and vascular malformations), similar to those delivered by Nd:YAG lasers, while retaining the benefits of diodes (lower cost, high speed, high durability, contact cooling in the applicator, and minimal maintenance)[9]. It has also been seen that side effects such as hyperpigmentation occur less frequently than with solid-state lasers, and that the treatments are more comfortable for the subject due to the contact cooling of the applicator, which reduces the sensation of pain during treatment[8].

The main limitation of the 1,060 nm diode laser compared to the 1,064 nm Nd:YAG laser is that it cannot reach such high fluences with short pulse durations. Nd:YAG lasers are used with fluences in the 200 J/cm^2 range and pulses of tens of milliseconds. Diode lasers, due to their much lower power, require pulses greater than 100 ms and do not reach such high fluences, so they are less effective, more painful and can present a greater risk of side effects. However, this can be compensated for by using multiple pulses[9].

II. Objective

The main objective of this study is to evaluate the efficacy, comfort and safety of diode-laser technology with a power of 2,000 W, a wavelength of 1,060 nm and an optimum size of 4x3 mm, which allows the same range of fluences and pulses durations as Nd:YAG lasers to be used on a broad array of facial and corporal vascular lesions of grade C_0 and C_1, such as telangiectasias, red and blue veins, cherry angiomas, fine reticular veins, venulectasias, spider veins and facial erythrosis. We aimed to select the most appropriate laser parameters depending on the subject, the characteristics of the lesion and the progress of the lesion during the treatment.

III. Materials and Methods

This prospective study considered 17 subjects (skin type II-V according to the Fitzpatrick scale) with a total of 78 treatment areas containing various vascular lesions in facial and corporal areas, such as telangiectasias (< 0.5 mm), venulectasias (0.5-1.5 mm), red and blue superficial veins, cherry angiomas, fine reticular veins (< 3.5 mm), spider naevi and erythrosis or rosacea (Table 1).

Different body areas were treated on 17 patients: face (15 areas), legs (47 areas), back (3 areas), abdomen (4 areas), foot (1 area) and chest (8 areas) (Table 2).

Subjects with vascular lesions in venous insufficiency equal to or higher than C_2 were excluded from the study because more invasive treatments would be required (e.g. sclerotherapy). In addition, subjects with autoimmune pathologies, infections or lesions in the treatment area, as well as those who were taking photosensitive drugs, were also excluded. Subjects with skin type VI according to the Fitzpatrick scale were not included because the melanin load has been found to be higher than the haemoglobin of the vascular lesions and this would compromise the safety and efficacy of the treatment. Subjects were recruited voluntarily and they authorised their participation by signing the consent form and the medical history in accordance with the declaration of Helsinki, good clinical practice, and the laws and regulatory requirements for the use of medical devices in Spain.

TABLE 1: Vascular lesions in facial and corporal areas.

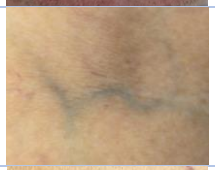
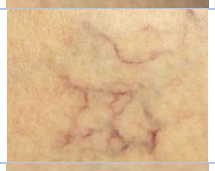
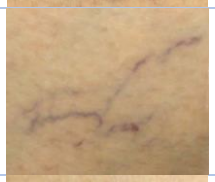
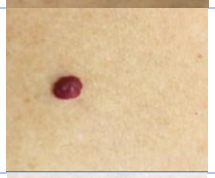
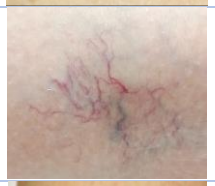
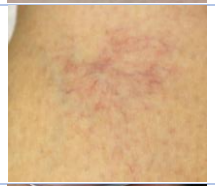
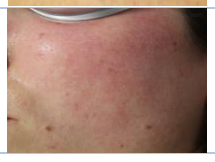
Vascular lesion type (Subject ID)	Photography
Telangiectasias (Subject 001)	
Venulectasias (Subject 010)	
Red superficial veins (Subject 011)	
Blue superficial veins (Subject 011)	
Cherry angiomas (Subject 002)	
Fine reticular veins (Subject 008)	
Spider naevi (Subject 004)	
Erythrosis (Subject 005)	

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TABLE 2: Lesions in each subject.

Subject ID	Nº of areas treated	Sex, age, skin type	Vascular lesion type	Vascular lesion localisation
001	8	M, 77, II	Telangiectasia	Face
002	7	M, 45, V	Cherry angioma	Back Chest
003	7	F, 49, III	Telangiectasia Spider naevus	Legs
004	2	F, 46, III	Spider naevus Blue vein	Legs
005	2	F, 29, III	Erythrosis	Face
006	3	F, 26, IV	Telangiectasia Blue vein	Legs
007	4	M, 2, III	Cherry angioma	Face Chest
			Telangiectasia	Abdomen
008	5	F, 27, II	Venulectasia Telangiectasia Reticular vein	Legs
009	5	F, 40, IV	Telangiectasia	Legs Foot
010	10	F, 29, III	Telangiectasia Reticular vein Venulectasia	Legs
011	9	F, 48, IV	Spider naevus Blue vein Telangiectasia Reticular vein Red vein	Legs
012	3	F, 38, V	Cherry angioma	Abdomen Back Face
013	2	M, 50, III	Cherry angioma	Chest Back
014	1	F, 28, III	Cherry angioma	Abdomen
015	4	F, 53, V	Telangiectasia	Legs
016	3	M, 37, III	Reticular vein	Legs
017	3	F, 27, III	Erythrosis	Face

The treatments were performed with a high-power diode laser device and a new 4x3 mm, 1,060 nm, 2,000 W applicator (the CE approved Primelase Excellence from Cocoon Medical, Barcelona, Spain), which emits laser radiation through an uncooled sapphire prism with an end surface of 4x3 mm, and cools the skin through two aluminium pivots surrounding the prism (Figure 1). The device is approved for the removal of vascular lesions under directive 93/42/EEC for medical devices by the notified body Nº 0051 and certificate number 1604/MDD.

The vascular lesions varied in size and typology, so the parameters used and the number of sessions were variable. The diode laser device allowed two modes of operation to be used: "static" and "dynamic". Treatments performed in static mode were carried out with a series of single high-energy shots overlapping over the entire treatment area. In dynamic mode, treatments were performed with a series of repetitive low-energy pulses while moving the applicator at a constant speed in horizontal and vertical sweeping motions to ensure uniform coverage of the entire grid (treatment area). The laser irradiation follows a square top-hat spatial pattern, which is the main distribution profile of laser diodes. The energy is evenly distributed over the entire area. All the patients underwent a "test session" to select the most appropriate parameters before the final treatment, according to clinical and dermoscopic endpoints (redness, darkening and/or whitening). Reaching a dermoscopic endpoint of 50% or vessel disappearance was considered adequate. Table 3 shows the parameters used.

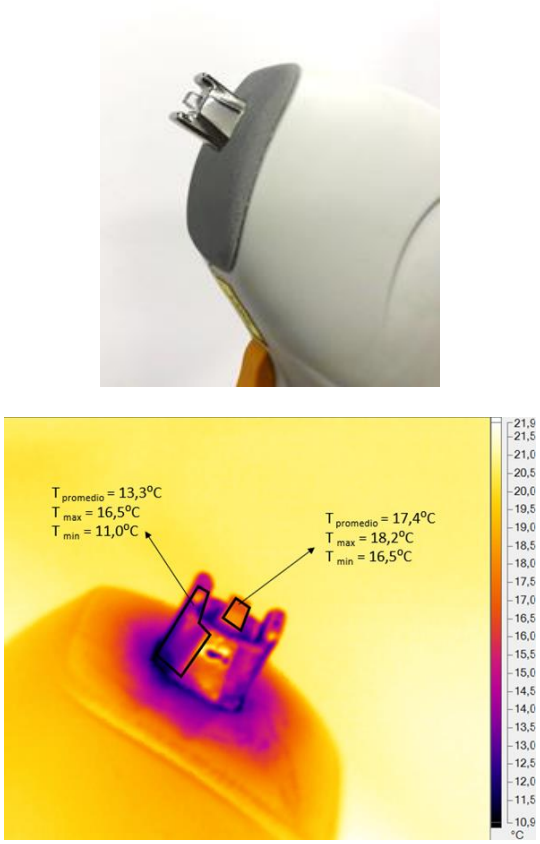

Figure 1: The 4x3 mm, 1,060 nm applicator of the Primelase Excellence. Thermal camera image of the applicator tip.

TABLE 3: Range of parameters used according to the vascular lesion.

Vascular lesion type	Localisation	Skin type I-IV
		Mode[1], Fluence (J/cm²), Pulse Width[2] (ms), Frequency (Hz), Passes/seconds
Blue vein	Legs	ST, 110-200, Auto (10-20)/20-30, 1, 1-3
Cherry angioma	Face, legs, chest, back, abdomen	ST, 100-180, Auto (9-17), 1, 1-4
Erythrosis	Face	ST, 100-120, Auto (9-11), 1, 1-2
Red vein	Legs	ST, 110-160, Auto (10-15)/20-30, 1, 1-3
Reticular vein (< 3.5 mm)	Legs	ST, 120-220, 30-50, 1, 1-3
Spider naevus	Legs	ST, 110-170, Auto (10-16) /20, 1, 1-3
Venulectasia (0.5-1.5 mm)	Legs	ST, 120-200, 20-30,1,1-3
Telangiectasia (< 0.5 mm)	Face	ST, 90-170, Auto (8-16)/ 20, 1, 1-3
	Legs, abdomen	ST, 90-225, Auto (14-25), 1, 1-3

[1]ST: Static, DM: Dynamic
[2]Automatic mode (Auto): the minimum pulse duration according to the programmed fluence.

The efficacy of the treatment was evaluated with photographs before the procedure and 35 to 45 days afterwards. The decrease in the diameter of the vascular lesion and the decrease in erythema in subjects with facial erythrosis were assessed using the 4-point Global Aesthetic Improvement Scale (GAIS): 0 = no result, 1 = mild result (1-25%), 2 = good result (26-50%), 3 = very good result (51-75%), and 4 = excellent result (76-100%). Subject satisfaction was also evaluated using a survey rated from 0 to 3 (0 = no, 1 = poor, 2 = good, and 3 = excellent results). The number of sessions for each area depended on the progress of lesion improvement.

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To assess pain during treatment, subjects were asked to rate pain as mild, moderate, severe or intolerable according to the VAS scale (0 = no, 1-3 = mild, 4-7 = moderate, 8-10 = severe or intolerable).

The endpoint was assessed immediately after treatment (redness, darkening and/or whitening), as well as post-treatment adverse effects (burning, haematoma and/or hyperpigmentation), and they were evaluated on a scale from 0 to 3 (0 = no, 1 = mild, 2 = moderate and 3 = severe).

A descriptive statistical analysis of the data obtained (mean and standard deviation) was performed using the Excel statistical package and unilateral z-student (one tail as the direction of the potential difference is known) for paired data. For statistical significance, the expected pain sensation was assumed to be less than 5.5 points out of 10, the endpoint more than 1.5 out of 3, the side effects less than 1.5 out of 3, and the efficacy more than 2 out of 4. Results were considered statistically significant if the p-value was less than 0.05 (95% confidence) and highly statistically significant if the p-value was less than 0.01 (99% confidence).

IV. Results

On the 78 areas treated, 248 treatments were performed in different sessions, which depended on the degree of improvement of the lesion 35-45 days after the last treatment (Table 4).

The mean treatment time was 2 minutes per area, varying according to the number of lesions in the treatment area. In the case of facial erythrosis, the mean time was 4 minutes.

The subjects' sensations were evaluated immediately after the session. Concerning pain, a mean of 4.95 (SD 2.45) points out of 10 was obtained on the VAS scale, with a moderate pain sensation, which was highly statistically significant ($p < 0.01$). Pricking was the most common pain sensation, present in 82% of the treatments with a mean score of 5.01 (SD 2.21) out of 10, followed by pricking and heat present in 12% with a mean score of 6.3 (SD 2.24), and a sensation of heat only was present in 2% of the treatments (mainly in dynamic mode) with a mean score of 3.75 (SD 3.50); no pain was felt in 4% of the treatments performed (Figure 2).

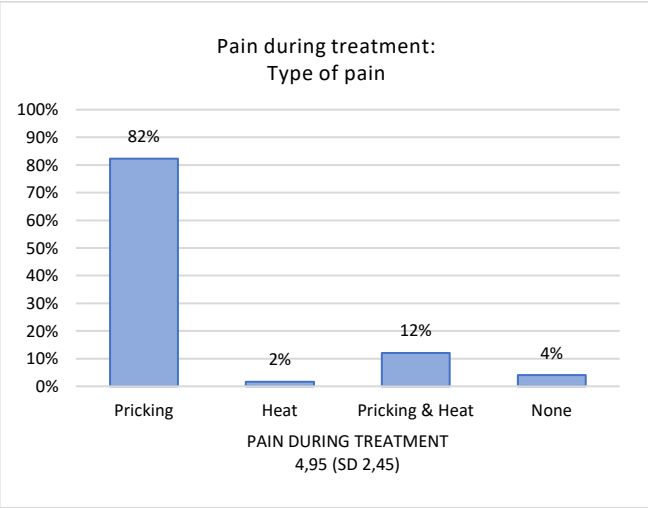

Figure 2: Pain during treatment: Type of pain; prevalence percentage, mean rating and standard deviation, $p < 0.01$.

TABLE 4: Subjects, areas treated, sex, age, skin type, vascular lesion, location and number of treatment sessions and the parameters used in each lesion and area.

Subject ID	Skin type	Vascular lesion type	Vascular lesion localisation	Session number	Mode, Fluence (J/cm2), Pulse Width (ms), Frequency (Hz), Passes/seconds
001	II	Telangiectasia	Face	3	ST, 100, Auto (9), 1, 1
002	V	Cherry angioma	Back Chest	3-4	ST, 110-180, Auto (10-17), 1, 1
003	III	Telangiectasia Spider naevus	Legs	5	ST, 120-140, Auto (11-13), 1, 3 ST, 120-140, Auto (11-13), 1, 2
004	III	Spider naevus Blue vein	Legs	6	ST, 130-160, Auto (12-15), 1,3 ST, 140-150, 20, 1, 3
005	III	Erythrosis	Face	5	ST, 100-110, Auto (9-10), 1, 4
006	IV	Telangiectasia Blue vein	Legs	4-5	ST, 140-190, 30, 1,2 ST, 130-150, 30, 1, 1
007	III	Cherry angioma	Face Chest	2-4	ST, 100, Auto (9), 1,1 ST, 100-150, Auto (9-14), 1, 1-3
		Telangiectasia	Abdomen	5	ST, 140-200, Auto (13-20), 1, 2-3
008	II	Venulectasia Telangiectasia Reticular vein	Legs	1-4	ST, 140-220, 20, 1, 1-3 ST, 160-220, Auto (15-20), 1, 1-2 ST, 160-220, 30, 1, 1-2
009	IV	Telangiectasia	Legs Foot	1-4	ST, 150-190, Auto (14-18), 1, 2
010	III	Telangiectasia Reticular vein Venulectasia	Legs	3	ST, 150-190, Auto (18), 1, 2 ST, 150-170, 50, 1, 2 ST, 130-180, 50, 1, 2
011	IV	Spider naevus Blue vein Telangiectasia Reticular vein Red vein	Legs	2	ST, 160, 30, 1, 1-2 ST,160,Auto (15), 1, 1-2 ST, 170-180, Auto (16-17), 1, 1-2 ST, 150-160, 30, 1, 1-2 ST, 150-160, 30, 1, 1-2
012	V	Cherry angioma	Abdomen Back Face	1-3	ST, 130-160, Auto (12-15), 1, 4 ST, 130-160, Auto (12-15), 1, 4 ST, 110-150, Auto (10-14), 1, 1-2
013	III	Cherry angioma	Chest Back	3	ST, 140-180, Auto (13-17), 1, 1-4 ST, 140-170, Auto (13-16), 1, 1-4
014	III	Cherry angioma	Abdomen	2	ST, 150-170, Auto (14-16), 1, 1-2
015	V	Telangiectasia	Legs	1	ST, 90, 20, 1, 1
016	III	Reticular vein	Legs	1	ST, 150-160, 30, 1, 1-3
017	III	Erythrosis	Face	1	ST, 110, Auto (10), 1, 4

The endpoint was evaluated immediately after each procedure. In the 248 treatments performed, a mild to moderate rating was obtained, with an overall mean of 1.73 (SD 0.66) out of 3, which is highly statistically significant ($p < 0.01$). Redness was observed in 77% of the treatments, with a score of 1.78 (SD 0.62); whitening in 8%, with a score of 1.52 (SD 0.61); darkening & redness in 8%, with a score of 1.85 (SD 0.67); darkening in 4%, with a score of 2.1 (SD 0.32); and whitening & redness only in 1%, with a score of 1.3 (SD 0.57). In 2% of the treatments, no endpoint was observed (Figure 3).

When evaluating the endpoint according to the vascular lesion, it was found that for telangiectasias redness was observed in 88.46% of treatments, followed by darkening (3.85%), darkening & redness (3.85%), whitening & redness

(1.92%), and whitening (0.96%). For venulectasias, redness was observed in 70% of treatments, followed by whitening (25%), and darkening (5%). For reticular veins, 68.75% had redness, 25% whitening, and 6.25% whitening & redness. For cherry angiomas, 52.08% had redness, 33.33% darkening & redness, and 8.33% darkening. For blue veins, 45% had whitening, 40% redness, and 5% darkening. For spider and erythrosis lesions, an endpoint of redness was observed in 100% of the treatments. In 10% of blue vein lesions, 6.25% of cherry angiomas, and 0.96% of telangiectasias there was no visible endpoint (statistically significant, $p < 0.05$).

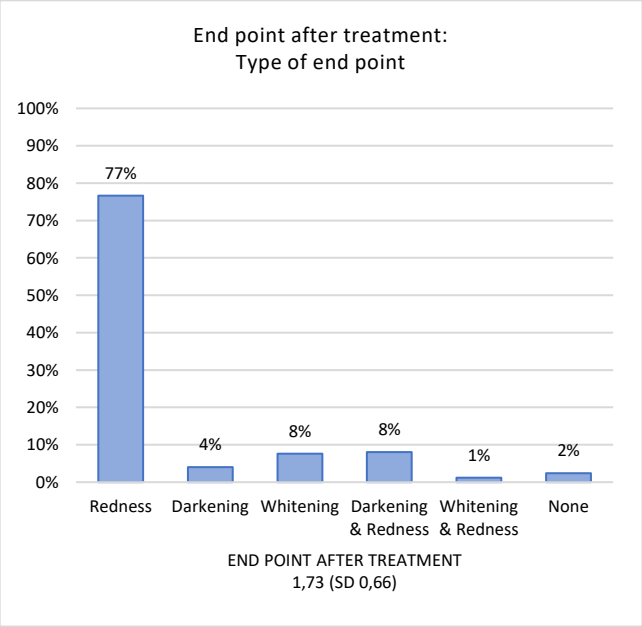

Figure 3: Endpoint after treatment: Type of endpoint and prevalence percentage.

The evaluation of clinical results was performed using the GAIS scale considering the last treatment session (Table 5)

TABLE 5: GAIS assessment of vascular lesion reduction according to the last session, $p < 0.01$.

Number of sessions	Number of areas	GAIS mean (SD) out of 4	Reduction assessment (%)
1	12	2.58 (SD 0.90)	26-50%
2	11	3.09 (SD 0.30)	51-75%
3	23	4.00 (SD 0)	76-100%
4	17	3.65 (SD 0.78)	51-75%
5	13	3.46 (SD 0.51)	51-75%
6	2	4.00 (SD 0)	76-100%
1 to 6	**78**	**3.48 (SD 0.73)**	**51-100%**

When evaluating the global result of the last session the mean rating obtained was 3.48 (SD 0.73) out of 4, classifying the effectiveness of the treatment as very good reduction (51-75%) and excellent reduction (76-100%), a highly statistically significant result ($p < 0.01$).

The evaluation of results according to the type of vascular lesion is shown in Table 6.

TABLE 6: Assessment of vascular lesion reduction according to the lesion type, $p < 0.05$.

Vascular lesion type	Number of areas	Mean number of sessions	Mean value of results (SD)
Telangiectasia	32	3	3.50 (0.72)
Blue vein	5	4	3.60 (0.55)
Cherry angioma	15	3	3.80 (0.56)
Erythrosis	5	3	2.80 (1.30)
Red vein	1	2	3.00 (0.00)
Reticular vein	7	2	3.43 (0.79)
Spider naevus	6	4	3.17 (0.41)
Venulectasia	7	3	3.57 (0.79)

When the results were evaluated according to the type of vascular lesion, the best results were observed for cherry angiomas with a mean value of 3.8 (SD 0.56) (very good result). The result with the lowest rating was erythrosis, with a mean value of 2.8 (SD 1.3) (good result). In both cases, the lesion was reduced in a mean of 3 treatment sessions.

In addition to the evaluation of results from a clinical point of view, subject satisfaction in the last session was also assessed. The overall rating of the 17 subjects in the study was 2.56 (SD 0.68) out of 3, with satisfaction ranging from good to excellent, this being a highly statistically significant result ($p < 0.01$).

Of the 248 treatments performed, 233 treatments registered no adverse effects (94%), while 15 treatments (6%) presented a haematoma or slight burns, affecting 3 subjects (2 slight burns and 1 haematoma). These events were evaluated on a scale of intensity from 0 to 3, with a mean of 1.6 points, rated as mild-moderate. These adverse effects remitted 72 hours after treatment, without affecting the results for vascular lesion reduction.

Examples of images obtained before, immediately after (endpoint), and 35-45 days after the last procedure are shown in figures 4 and 5.

V. Discussion

The 1064 nm Nd:YAG laser is known to be the most popular method for almost all vessel sizes (up to 3 mm in diameter) and is safe on most skin types, with spot sizes of a few millimetres, short pulse durations (< 50 ms) and fluences of between 100 and 200 J/cm^2. The new 2,000 W diode laser applicator, with the same wavelength as Nd:YAG lasers and a spot size of 4x3 mm, features all of these specifications and therefore is able to deliver the same performance as Nd:YAG lasers. This has been shown in the study, with good to excellent results achieved on a wide range of vascular lesions: telangiectasias, red and blue veins, cherry angiomas, fine reticular veins, venulectasias, spider veins, and erythrosis. Participants were highly satisfied with their outcomes, corresponding with the minor side effects and objective improvement following the treatment.

The advantage of using diode-laser devices is primarily the significantly lower cost compared to other high-power solid-state lasers. Other benefits include longer durability; contact cooling; higher shot frequency; the absence of optic lamps, expensive optics and crystals; and minimal maintenance. Further advantages of the current device lie in its particularly long wavelength, which is equal to that of Nd:YAG lasers, with less absorption by the melanin and higher absorption by the

Reyna Vargas Lamas, Gregorio Viera Mármol, Gabriela Vergara Vallejo, Marta Castillejos Pallàs, José Antonio Ferrández Martínez, Carmen Cano Ochoa, and Jorge Villena García, "New 2,000 W, 1,060 nm Diode Laser with a Spot Size of 4x3 mm for Vascular Lesion Treatments", *International Research Journal of Pharmacy and Medical Sciences (IRJPMS)*, Volume 5, Issue 2, pp. 19-25, 2022.

haemoglobin compared to other shorter diode wavelengths such as 810 nm, thus ensuring minimal risk of epidermal damage. This is especially important among patients with skin types that are higher on the Fitzpatrick scale.

Effectiveness, comfort and safety have been assessed and the device has proven to be a good non-invasive option for the treatment of vascular lesions of grade C_0 to C_1 in facial and corporal areas, according to the immediate endpoint of all the lesions and the follow-up after several treatments on skin types II to V. Clinical evaluation of the results after the last treatment showed that subjects experienced favourable progress, decreasing the lesion by 51 to 100% of the initial vessel.

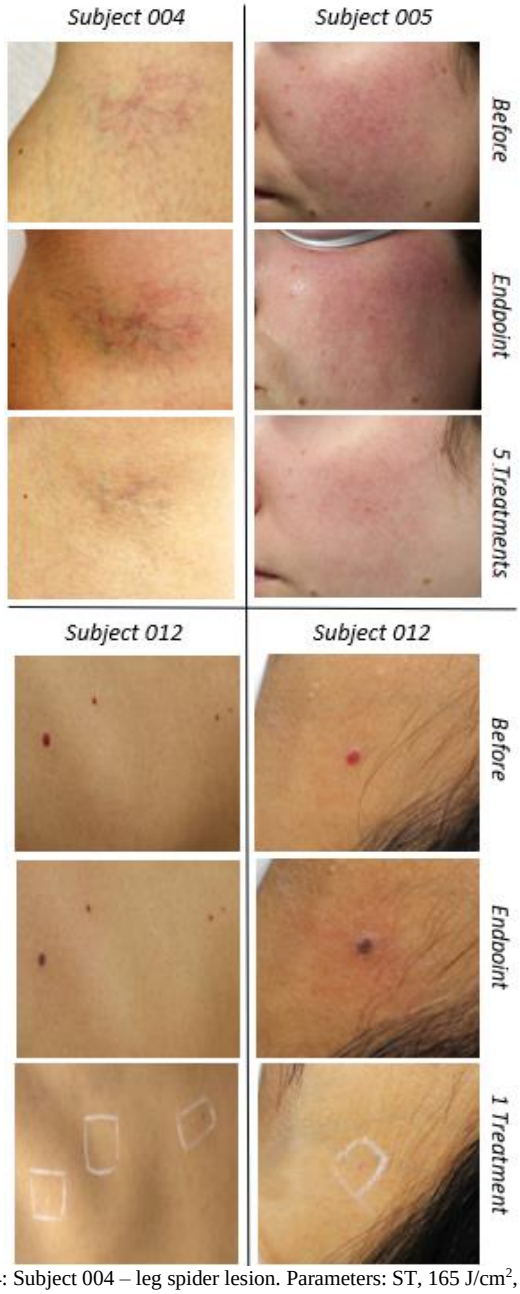

Figure 4: Subject 004 – leg spider lesion. Parameters: ST, 165 J/cm^2, 18 ms, 1 Hz, 2 passes, 5 treatments. Subject 005 – facial erythrosis. Parameters: ST, 110 J/cm^2, 10 ms, 1 Hz, 4 passes, 5 treatments. Subject 012 – facial and abdomen cherry angioma. Parameters: ST, 150-160 J/cm^2, 14 ms, 1 Hz, 1 pass, 1 treatment.

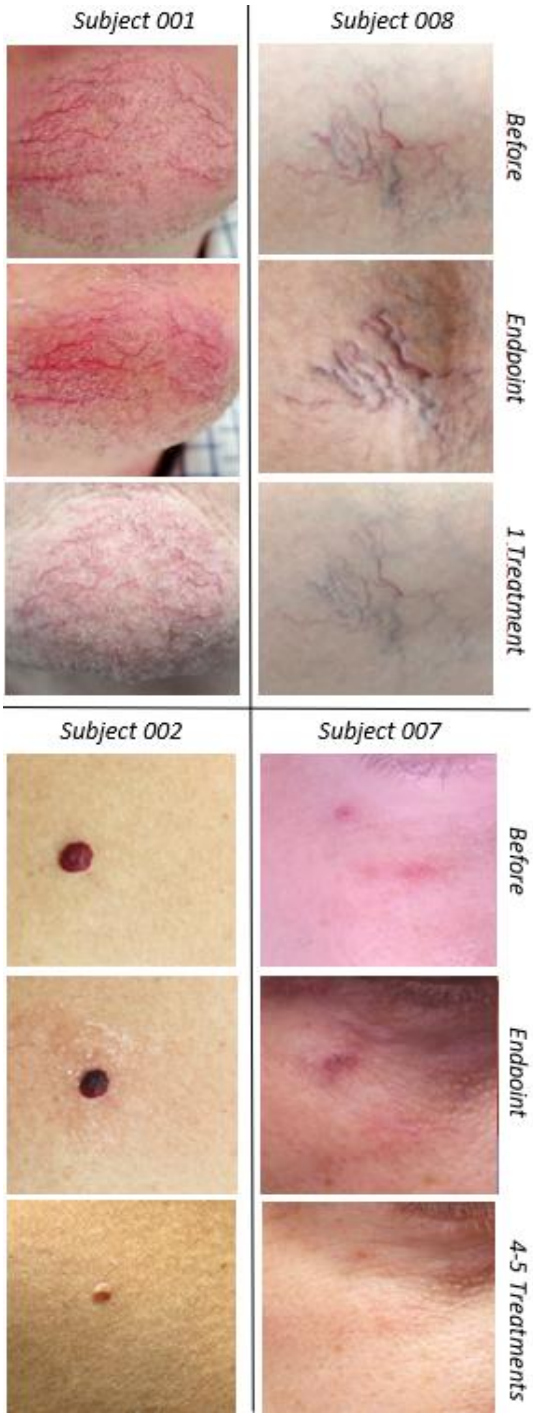

Figure 5: Subject 001 – Facial telangiectasias. Parameters: ST, 100-110 J/cm2, 8-10 ms, 1 Hz, 1 passe, 1 treatment. Subject 008 – leg reticular vein. Parameters: ST, 150 J/cm2, 14 ms, 1 Hz, 1 pass, 1 treatment. Subject 002 – Chest cherry angioma. Parameters: ST, 140 J/cm2, 12 ms, 1 Hz, 2 passes, 4 treatments. Subject 007 –Face cherry. Parameters: ST, 130 J/cm2, 12 ms, 1 Hz, 2 passes, 5 treatments.

Subjects treated with lower parameters presented less pain and less signs of an endpoint than other subjects treated with higher parameters; the treatment parameters must therefore be optimised in accordance with the Fitzpatrick-scale skin type that the subject presents at the time of the procedure. It is necessary to evaluate the skin type before each procedure and

find the maximum fluence that is safe for the skin, thus avoiding both ineffective treatments and adverse events caused by very high parameters.

The subjects who were treated in dynamic mode experienced a sensation of pricking pain in conjunction with localised heat. Treatment in dynamic mode was slightly more uncomfortable than in static mode, this being related to the fact that in static mode the pricking sensation is brief whereas in dynamic mode it is maintained for a certain period of time. In subjects with erythrosis, the static mode produced a higher endpoint and better results compared to the use of the dynamic mode.

In cherry angioma lesions the pain was mild, while the endpoint and results ranged from very good to excellent.

According to the assessment of the results, it has been possible to eliminate vascular lesions in 2 to 6 sessions depending on the lesion (improvement higher than 50%).

VI. Conclusions

The use of diode lasers with a wavelength of 1,060 nm has been shown to be a very good non-invasive option for the treatment of vascular lesions on light and dark skin types and in facial and corporal areas. The new optimised design of the 4x3 mm applicator allowed for the treatment of vascular lesions such as telangiectasias, red and blue veins, cherry angiomas, fine reticular veins, venulectasias, spider veins and erythrosis.

Fluences ranging from 90 to 225 J/cm^2, pulse durations between 8 and 50 ms, and between 1 and 6 sessions were used.

The treatments were comfortable for all, with patients reporting mild to moderate pain during the treatment.

The safety of the treatment was evaluated with no evidence of serious side effects after treatment in all lesions and skin types up to V on the Fitzpatrick scale.

The treatment time was fast and short, with a mean time of 2 minutes per area, varying according to the number of lesions in the treatment area. In the case of facial erythrosis, the mean time was 4 minutes.

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Conflicts of Interest

Some of the authors of this publication conduct research at Cocoon Medical S.L.U., a company that is developing products related to the research being reported. However, this publication strictly adheres to the objectivity and ethics of independent research.

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