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Original Research

A New 675 nm Laser Device in the Treatment of Melasma: Results of a Prospective Observational Study

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Abstract

Objective: This study evaluates the efficacy and safety of a new 675 nm laser source system on melasma.
Background: Melasma is an acquired circumscribed hyperpigmented disorder that has a negative impact on patients' life quality. Different treatments are currently available. This study evaluates this new 675 nm laser source system, on melasma with the use of established parameters that guarantee minimum pain, the absence of side effects, and simplifying posttreatment management.
Materials and methods: A total of 25 subjects (all women, 21–50 years old), with facial melasma and Fitzpatrick skin types I–III, were treated with three sessions of a new 675 nm laser system. Efficacy of treatment was evaluated using Melasma Severity Index (MSI) score before and 3 months after the last session. The appearance of side effects has also been monitored to evaluate safety. A preclinical study was executed to evaluate laser effectiveness on sheep skin.
Results: All 25 subjects treated with the 675 nm laser had significant improvement in melasma according to MSI score (mean baseline MSI 26.4 ± 19.2; mean 3-month follow-up MSI 17.3 ± 15, p: 0.003). Histology in preclinical study showed selective damage of melanin-rich areas. No side effects have been observed except some minor erythematous reactions in two patients.
Conclusions: Due to its high affinity with melanin, and its minimal interaction with the vascular component, novel 675 nm laser may be considered promising when treating benign pigmented lesions with a low risk of side effects and simple posttreatment management.

Keywords: 675 nm, laser, melasma

Introduction

Melasma is a frequent acquired skin disease defined by the presence of hyperpigmented macules on the face. Its prevalence is 1–5% in the general population, and may reach 30% in specific areas such as in Southeast Asia or Latin America.[1]

Sun exposure and hormonal dysregulation seem to play a major role, involving keratinocytes, inflammatory cells, increased vascularization, abnormal elastic fibers, and basement membrane disruption. Its pathogenesis is not still completely understood.

Recently, tremendous scientific interest was shown in researching novel, safe, and effective topical agents to manage melasma.[2] Among others, tranexamic acid (TA)[3] received strong clinical recommendations for the treatment of melasma. Oral TA may be used in the treatment for refractory melasma after screening for thromboembolism.[4] Chemical peels in combination with other drugs also showed significant improvement in melasma.[5]

Regarding physical therapies, lasers and light sources have been used with variable results. The 1064 nm picosecond[6] and nanosecond[7] lasers showed to be safe and effective in treating melasma. Up to date, no melasma treatment has shown definitive results, and none of these treatments has been demonstrated to prevent frequent relapses or associated hyperpigmentation.[1]

In this open study, we used a new 675 nm nonablative laser (RedTouch™; Deka Me.La, Calenzano, Italy) on 25 female patients (aged 21–50) presenting facial melasma.

The aim of this article is to evaluate effectiveness and safety of this novel device in the treatment of melasma.

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Table 1. 675 nm Nonablative Laser (RedTouch, Deka Me.La, Calenzano, Italy) Technical Specifications

Technical specifications	*Available*	*Used in the protocol*
Wavelength	675 nm	675 nm
Power	Up to 10 W	10 W
Scan area size	Up to 15 × 15 mm	15 × 15 mm
Scanning shapes	Point, line, triangle, ellipse, hexagon, square	Square and ellipse
scan modes	Normal, Interlaced, SmartTrack	SmartTrack
Dwell time	50–1000 ms	100 ms
Spacing	0–4 mm	0.5 mm
SmartStack	1–5	1
Integrated skin cooler	Down to 5°C	5°C

The high affinity for the melanin chromophore makes this device promising in the treatment of melasma, especially the nonvascularized type, even at very low energies. The 675 nm wavelength laser system also targets dermal collagen. This mechanism of action makes this system suitable also for aging-induced skin disorders.[8] Therefore, the numerous possible combinations of the above mentioned operating parameters allow to obtain different effects and therefore to treat various aspects of photoaging.

Materials and Methods

Twenty-five female patients (mean age 35.64 ± 8.76) affected by facial melasma were selected for this open study and treated at the Dermatologic Unit of University of Rome ''Tor Vergata'' and at the Dermatological Unit of Magna Graecia University in Catanzaro, Italy. This study was approved by Ethics Committee Calabria Centro with reference no. 373/2019.

Exclusion criteria for the study were the following: (1) patients hypersensitive to light in the near-infrared wavelength region, (2) the use of photosensitizing agents, (3) the use of anticoagulant and/or immunosuppressant, (4) patients with seizure disorders triggered by light, (5) pregnant patients, (6) patients with personal or family history of skin cancer, (7) patients exposed to the sun during the 3 weeks before treatment, (8) the presence of tattoos or skin disorders on the treated areas, and (9) any kind of melasma treatment in the previous 2 months.

Laser device

The laser system used (RedTouch; Deka Me.La) emits a 675 nm wavelength red light through a 15 × 15 mm scanning system capable of hitting melanin selectively as reported in preclinical studies. The delivered energy can be managed through different parameters (power, pulse duration, and distance between microthermal zones).

The system is equipped with a contact 5°C skin cooling system to preserve epidermis from heat-induced damage.

Laser treatment protocol

Before treatment, face was cleaned with mild soap and rinsed with water.

Assessment of the energy to treat each patient was carried out on a ''test'' area based on the subject's skin type and degree of tolerability. The answer of the test was noticeable within 5/10 min. The end point was considered a mild erythema and some associated edema.

Patients were treated with three sessions of a 675 nm nonablative laser (RedTouch; Deka Me.La). Parameters used were the following: power: 10 W, pulse duration: 100 ms, spacing: 0.5 mm, and cooling: 5°C. All treatments were performed using a transparent conductive gel. Sessions were performed with a 30-day interval. System technical specification of the machine and parameters used in the protocol are available in Table 1.

Treatment was carried out by passing the handpiece in contact with the skin surface, without excessive pressure, with consecutive spots, and no overlapping on affected areas. Two laser passes were performed. Areas close to the bone surface (forehead, cheekbone, and so on) were treated with only one passage to avoid minor burns and/or hyperpigmentation. Application of topical anesthetics was optional: it was used in only two patients and completely removed before treatment.

Posttreatment regimen

After treatment, skin was cooled with cold water-soaked gauzes and nonsteroidal anti-inflammatory cream based on B12 vitamin[9] was applied twice a day for 2 weeks. Postoperative recommendations included the use of total block mineral sunscreens for the all treatments and the whole follow-up period.

Treatment outcomes

Treatment outcomes (melasma severity) were assessed clinically comparing digital photographs before, after each session, at a 3-month follow-up and measuring the Melasma

Table 2. Melasma Severity Index Score (from Majid et al.[10])

MSI score	*Scoring of pigmentation*	*Scoring for area involvement*
$MSI = 0.4\ (a \times p^2)\ l + 0.4\ (a \times p^2)\ r + 0.2\ (a \times p^2)\ n$	Score 0: no visible pigmentation	≤10% area involved: score 1
In the formula, ''a'' stands for ''area of involvement,'' ''p'' for ''severity of pigmentation,'' ''l'' for left face, ''r'' for right face, and ''n'' for nose.	Score 1: barely visible pigmentation	11–30%: score 2
	Score 2: mild pigmentation	31–60%: score 3
In cases with uniform pigmentation score can be further simplified as: $MSI \equiv a \times p^2$	Score 3: moderate pigmentation	>60%: score 4
	Score 4: severe pigmentation	

MSI, Melasma Severity Index.

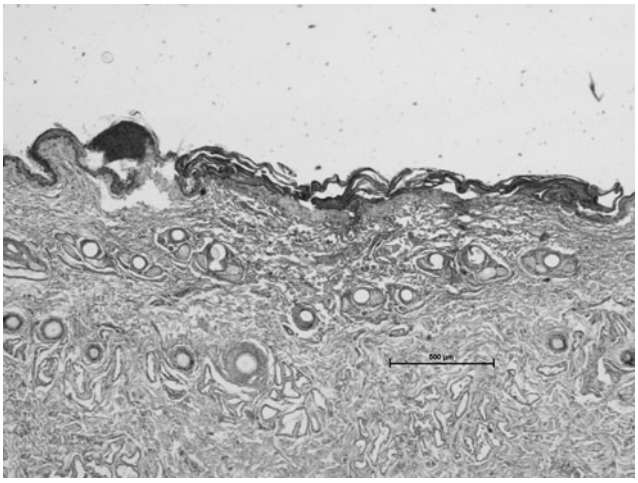

FIG. 1. Data show an induced injury of melanin-containing epidermal cells via photothermal effects due to the high absorption spectrum for melanin at 675 nm. The homogeneous damage of the pigment component is developed in the entire scan area of 6 mm in the pigmented tissue that, macroscopically, can be attributable to a paradoxical blackening.

Severity Index[10] (MSI) score. This score is calculated using the following formula:

$$\mathrm{MSI} = 0.4(\mathrm{a}\times\mathrm{p}^2)\mathrm{l} + 0.4(\mathrm{a}\times\mathrm{p}^2)\mathrm{r} + 0.2(\mathrm{a}\times\mathrm{p}^2)\mathrm{n}$$

In the expression, ''a'' stands for ''area of involvement,'' ''p'' for ''severity of pigmentation,'' ''l'' for left face, ''r'' for right face, and ''n'' for nasal area.

Dimension of the affected areas and severity of pigmentation are scored from 0 to 4 (Table 2).

Pain was measured using a Visual Analog Scale of 10 points.

The appearance of side effects such as blistering, scarring, burns, hypopigmentation, or hyperpigmentation has also been monitored. Paired Student's *t* test was performed to assess if the reduction in MSI score was statistically significant. Statistical analyses were performed using SPSS software ver. 25.0 (IBM, Armonk, NY).

Preclinical study/histological analysis or light microscopy analyses

An animal model was developed to evaluate the effects of the 675 nm red touch laser. A pigmented ex vivo shaved skin area in the groin of a sheep was chosen as the thin epidermal layer is similar to human facial skin. The skin was treated with the RedTouch device (power: 10 W, dwell time: 100 ms, spacing: 0 mm, cooling: 5°C, 6 mm circular scanning area).

Two millimeters punch biopsies were performed right after laser treatment. The specimens for histological analyses were fixed in 10% neutral formalin, dehydrated through a graded series of alcohol (or ethanol), cleared in Histoclear, and embedded in paraffin. Four to five micrometers thick sections obtained were stained with hematoxylin and eosin for light microscopy evaluation.

Photomicrographs were taken with a Nikon microscope, through a digital photo camera (Nikon Digital Sight DS-U1)) connected with a personal computer hosting the software Nis Elements D 3.2 (Nikon).

TABLE 3. PATIENTS CHARACTERISTICS

ID	*Sex*	*Area*	*Treatment*	*Age*	*Photo type*	*MSI score before treatment*	*MSI score after 3 months visit*	*Pain*	*No. of treatments*	*Side effect*
1	F	Face	Melasma	22	2	12	12	1	2	None
2	F	Face	Melasma	37	2	8.2	5.8	1	3.5	None
3	F	Face	Melasma	43	2	20.2	16	2	3	None
4	F	Face	Melasma	21	2	26.4	24	1	1	None
5	F	Face	Melasma	49	3	64	62	1	1	None
6	F	Face	Melasma	28	3	27	23	1	2	None
7	F	Neck	Melasma	34	2	18.2	16	1	2	None
8	F	Face	Melasma	31	3	6.6	4	1	2	None
9	F	Face	Melasma	45	2	32.8	30	1	2	None
10	F	Face	Melasma	26	3	6.4	4	1	2	None
11	F	Face	Melasma	32	2	9.6	5	1	3.5	None
12	F	Face	Melasma	39	2	15.2	12	2	3	None
13	F	Face	Melasma	25	2	21.4	17	1	3	None
14	F	Face	Melasma	46	3	9.6	7	1	2	Burns
15	F	Face	Melasma	42	2	20.6	18	2	2	None
16	F	Face	Melasma	48	3	13.2	10	1	3	None
17	F	Face	Melasma	45	2	32	32	2	1	None
18	F	Face	Melasma	32	3	7.6	4	1	3	Burns
19	F	Face	Melasma	29	3	4	2	1	2	None
20	F	Face	Melasma	28	3	10	8	1	2	None
21	F	Face	Melasma	36	2	8	6	1	2	None
22	F	Face	Melasma	44	2	46	46	1	2	None
23	F	Face	Melasma	48	3	39	36	1	2	None
24	F	Face	Melasma	27	2	22	20	1	2	None
25	F	Face	Melasma	34	3	4.1	2	1	2	None

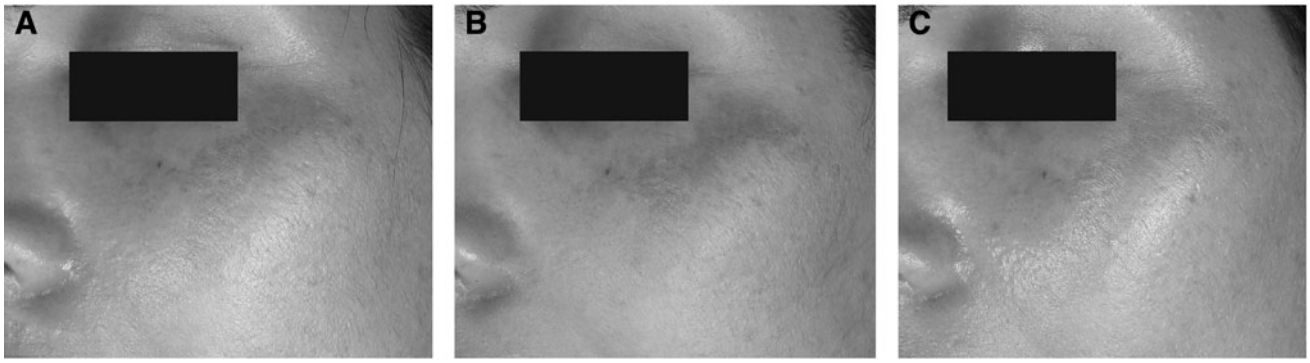

FIG. 2. **(A)** Patient at baseline. **(B)** Patient right after treatment. **(C)** Patient at 3-month follow-up.

Results

Preclinical histologic study shows homogeneous damage of the pigment component on the entire scan area in the pigmented tissue macroscopically attributable to a paradoxical blackening (Fig. 1).

Twenty-two out of 25 patients (mean age 35.64 ± 8.76) treated with the 675 nm RedTouch laser had significant improvement of melasma according to MSI score and photographic evaluation. The scores decreased from baseline (mean MSI 26.4 ± 19.2) to 3 months follow-up (mean MSI 17.3 ± 15) after the last treatment. A mean 30% reduction of MSI was assessed. The decrease was statistically significant (p: 0.003). Treatment was well tolerated (pain score: 3.12 ± 2.05) by all patients. Most patients reported pain associated to the procedure as mild. Two patients reported minor erythematous-vesicular side effects due to an incorrect positioning of the handpiece on the skin. These resolved in a few days after a low potency steroid cream daily application (Table 3) (Figs. 2–4).

Discussion

Treatment of hyperpigmentation remains a challenge. The mainstay of melasma treatment is to avoid sunlight exposure and to use topical depigmenting agents.[11]

Positive effects have been shown using low-energy Nd:YAG lasers on melasma.[12] Also, laser-like light-emitting diodes (LEDs) may likely improve hyperpigmentation.[13] Furthermore, LED treatment reduced melanogenesis through decreased expression of tyrosinase family genes. These results suggest that LEDs may potentially be utilized in the treatment of melanin-overproducing skin conditions.[14]

More specifically, lights with a 650–950 nm wavelength can hit melanin chromophores. Lights below 650 nm are mainly absorbed by hemoglobin and lights with a wavelength higher than 950 nm are absorbed by water.[15]

The wavelength between 650 and 850 nm is the better one to selectively target melanin, as light absorption coefficient for hemoglobin is lower, and for water, it is higher. An optimal wavelength of 650–700 nm targets melanin, has melanin absorbance continues to decrease with the increase of wavelength.[8]

A statistically significative mean improvement of 30% in MSI was observed at 3 months follow-up. Treatment is easy to perform, noninvasive and involves minimal side effects (redness, rare microburns). Procedure is painless when appropriate skin cooling of treated areas is performed before laser application. Neither microscopic epidermal necrotic debris nor dermoepidermal detachment was shown after treatment unlike what occurs typically after treatments with near infrared laser systems.[13]

The absence of crusts and/or microcrusts in the postoperative time makes treatment comfortable.

The 675 nm laser acts on melanin but does not interact with the vascular component. Preclinical study showed a selective damage to melanin component, sparing other skin structures. For this reason, it may be promising for the treatment of pigmented, chronoaging- and photoaging-related disorders.[12]

After this laser protocol, we observed a good outcome with no relapse at the 3-month follow-up. Limitations of this work include a limited group of patients and the absence of a control group. Also photographs assessment to evaluate melasma severity did not use a standardized system or software analysis, but was based on a subjective investigator evaluation.

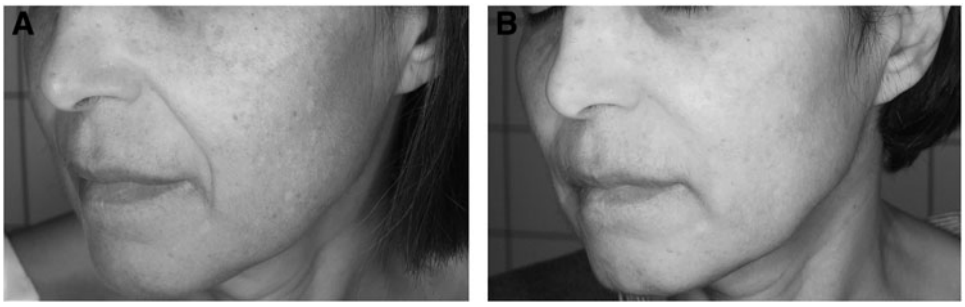

FIG. 3. **(A)** Patient at baseline; **(B)** patient at 3-month follow-up.

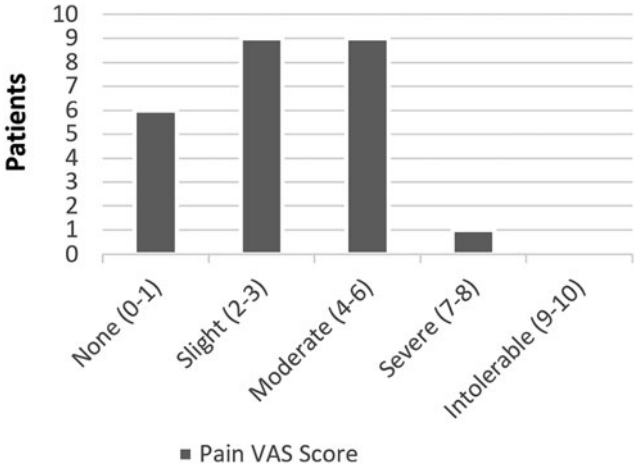

FIG. 4. Pain VAS with diagram. VAS, Visual Analog Scale.

Conclusions

This work shows that the 675 nm laser source system we investigated is effective and safe in the treatment of facial pigmentary disorders. Side effects were minimal and post-treatment management was very comfortable. Of course, studies on a larger group of patients and a longer follow-up period would be necessary to better evaluate the effectiveness of this laser source in the treatment of melasma.

Author Disclosure Statement

No competing financial interests exist.

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