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Efficacy of 577 nm pro-yellow laser in the treatment of melasma: a prospective split-face study

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ABSTRACT

We aimed to study the effectiveness of 577 nm pro-yellow laser in the treatment of melasma. A total of 82 patients with melasma were included in this comparative study. A detailed medical history, examination, and calculation of Melasma Area and Severity Index were done for all patients. All participants were treated with topical sunscreen and hydroquinone 4% cream on both sides of the face. In addition, the left side of the face was subjected to a single pass of 577-nm pro-yellow laser at a monthly interval for three sessions. Follow up was done by comparing the Melasma area and severity index at 0, 3 and 6 months. At baseline, there is no significant difference in the Melasma area and severity index score between both sides of the face. At 3 months, MASI score was statistically significantly decreased on both sides of the face compared to pretreatment ($P < .05$). At 6 months, the mean MASI score at the laser-treated side was statistically significantly decreased compared to the non-laser-treated side ($P < .05$). we concluded that the addition of 577 nm pro-yellow laser in the treatment of melasma leads to maintain the improvement and reduction of the recurrence rate.

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Melasma; pro-yellow laser; hydroquinone cream

Introduction

Melasma is a common acquired condition of symmetric hyperpigmentation, typically occurring on the face (1). Melasma appears as irregular macules and patches ranging from light-to dark-brown commonly seen in darker-skinned women (2).

The pathogenesis of melasma is not yet fully understood, stimulation of melanocytes by ultraviolet light exposure is the most accepted theory. Genetics, hormones, and photosensitizing medications may contribute to UV sensitivity (3).

Another theory suggests that increased vascularity is one of the major findings in melasma. Human melanocytes may respond to angiogenic factors because normal human melanocytes express functional vascular endothelial growth factor receptors (4).

Many treatment options for melasma as broad-spectrum photoprotection, topical compounds, Chemical peels and laser therapies (5). Hydroquinone is the gold standard for the treatment of melasma commonly used at concentrations of 2–4%. It is effective in treating melasma through suppression of melanin synthesis through inhibiting the sulfhydryl groups and acting as a substrate for the tyrosinase. Additionally, generation of reactive oxygen species and quinones can result in the oxidative damage of tyrosinase (6).

Laser devices are often employed to treat pigmentary disorders through their photothermal, photomechanical, and ablative effects. The pro-yellow laser, at 577 nm, has an ideal wavelength for treating cutaneous vascular disorders. This laser can target both the vascular and pigmented components of melasma (7).

Patients and methods

This is a prospective study carried out after being approved by The local Ethics Committee. This study was performed at the Dermatology department of Al-Azhar University Hospital, Assiut, Egypt, during the period from October 2015 to April 2018. All Patients were informed about the study procedures, risks, benefits, potential complications, and side effects. Participants who accept the study protocol were included in the study after signing an informed consent form.

Participants in this study (n = 82) patients with melasma, aged more than 16 years, with Fitzpatrick skin phototypes ranging from Type III to Type IV, were recruited. The exclusion criteria were pregnant or nursing women, patients with a history of active facial bacterial, viral or fungal infections, history of poor wound healing or keloid formation, photosensitivity, previous esthetic surgery in the last 6 months, systemic diseases and systemic steroids or isotretinoin therapy in the last year, and immuno-compromising diseases.

A detailed history of age, sex, duration of melasma, family history, previous treatment, triggering factors of melasma, residence, and occupation was taken. A dermatologic examination was performed to clinically classify the type of melasma into centrofacial, malar, or mandibular patterns, and Wood light examination was performed for the determination of the type of melasma (epidermal, dermal, or mixed).

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All patients were treated with topical sunscreen with SPF more than 50 and hydroquinone 4% cream (Meloquine 4% cream, Biopharm company, Egypt) on both sides of the face and the left side of the face was treated monthly with a single pass of 577-nm pro-yellow laser (QuadroStar PRO YELLOW® Asclepion Laser Technologies, Germany). Parameters used: scanner mode, initial fluence was 14 J/cm2 and increased by 2 J/cm2 every session and 80% coverage for 3 sessions.

Prior to the procedure, patients were instructed to avoid sun exposure during and after the treatment and to regular use a broad-spectrum sunscreen. On the day of treatment, patients were advised to wash thoroughly with soap and water and not to put any makeup. During treatment, the patient and physician wear specific goggles to guard against harmful effects of laser on eyes. Saline-moistened gauze was used under opaque patient goggles to ensure that the patient's eyes remain closed during treatment.

Postoperative care included a moisturizer applied in circular motions can aid in decreasing the sunburn-like sensations and avoid exposure to sun 2 weeks after treatment. No harsh soaps, scrubs, glycolic or retinoic acid-containing products or manipulation of the treated areas are permitted. In addition, the Patients were advised to use sunscreen regularly.

Melasma area and severity index (MASI) score for both sides was calculated at 0, 3 and 6 months follow up according to the method described by Kimbrough-Green et al. (8). Digital photographs of the lesions were taken before and after every session to assess any changes in the clinical appearance and to evaluate the response to treatment. All photographs were taken with an Olympusc-420 digital SLR camera 10 megapixels, using identical camera settings, lighting, and patient positioning.

Statistical evaluation

The data were analyzed using SPSS program (SPSS Inc., Chicago, IL) Version 22.0. Mean ± standard deviation (SD) was used for quantitative data and number (n) and percentage (%) for qualitative data. The following tests were used for the analysis of the results: paired sample t-test, and analysis of variance. Relationships between values were studied by Spearman correlation test. A p-value <0.05 was considered statistically significant.

Results

The final study cohort was made up of 82 patients (4 males and 78 females) with melasma, with a mean age of the patients was 34.22 (range16–51 years) and the mean duration of melasma was 6.48 ± 4.93 years (range 1–25 years). Based on Fitzpatrick skin type, patients were classified into: 48 (58.5%) patients were grade III and 34 (41.5%) patients were grade IV. Family history was positive in 40 (48.8%) patients and negative in 42 (51.2) patients. By Wood's light examination, 64 (78%) patients had an epidermal melasma, 15 (18.3%) patients had a dermal-type and 3 (3.7%) patients had a mixed-type (Table 1).

At baseline, there is no significant difference in MASI score between the two sides of the face. At 3 months, compared to baseline; MASI score was statistically significantly decreased on both sides of the face ($P < .05$), but there is no significant difference between laser-treated side and non-laser-treated site ($P \geq 0.05$). After 6 months, the mean MASI score at the laser-treated side (left side of the face) was statistically significantly decreased than non-laser-treated side (right side) ($P < .05$) (Table 2, Figure 1).

There was no significant relation between improvement of melasma and patient ages, sex, Skin photo-type, family history, and duration or site of melasma, while; there was significant relation between improvement and type of melasma (Table 3). Side effects reported in this study were hyperpigmentation in 2 (2.4%) and transient erythema in 5 (6.1%) patients.

Table 1. Clinical characteristics of studied population.

Age/year Mean ± SD (Range)	34.22 ± 6.69 (16–51)
Duration of melasma/years Mean ± SD (Range)	6.48 ± 4.93(1–25)
Female	78 (95.1%)
Female	4 (4.9%)
III	48 (58.5%)
IV	34 (41.5%)
Positive family history	40 (48.8%)
Site of melasma	
Centrofacial	39 (48%)
Malar	38 (46%)
Mandibular	5 (6%)
Type of melasma	
Epidermal	64 (78%)
Dermal	15 (18%)
Mixed	3 (4%)

Table 2. Mean ± SD MASI score of melasma at right and left sides of the face at 0, 4 and 6 months after treatment.

	Right side	Left side	P value
At baseline	7.31 ± 4.76	7.26 ± 4.76	.49
After 3 months	0.7 ± 1.35	0.7 ± 1.35	.34
After 6 months	2.54 ± 2.45	1.16 ± 1.8	.001*

***Significant $p < .05$**

Discussion

There is growing evidence indicating that melasma lesions have an increased vascularization (4,9–11). However, the role of this vascular component in the pathogenesis of melasma is still controversial. In some types of melasma, pronounced telangiectasia in lesional skin has been observed and topical tranexamic acid (plasmin inhibitor) is an effective therapeutic option in the treatment of melasma (4,12).

Vascular lasers may serve as an effective therapeutic option in the treatment of melasma especially in resistant cases (13). Galeckas et al. (14) reported that pulsed dye laser and intense pulsed light were highly effective in the photorejuvenation of vascular and pigmented facial dyschromias. Hassan et al. (15) reported that both PDL and IPL were effective and safe treatment modalities for lightening of melasma. VEGF can be proved as a possible mechanism underlying the action of both PDL and IPL on melasma.

The aim of this study was to study the effectiveness of 577 nm pro-yellow laser in the treatment of melasma.

In the current study, after treatment; there is an equally significant improvement of melasma in both sides of the face (Hydroquinone treated site and hydroquinone plus pro yellow

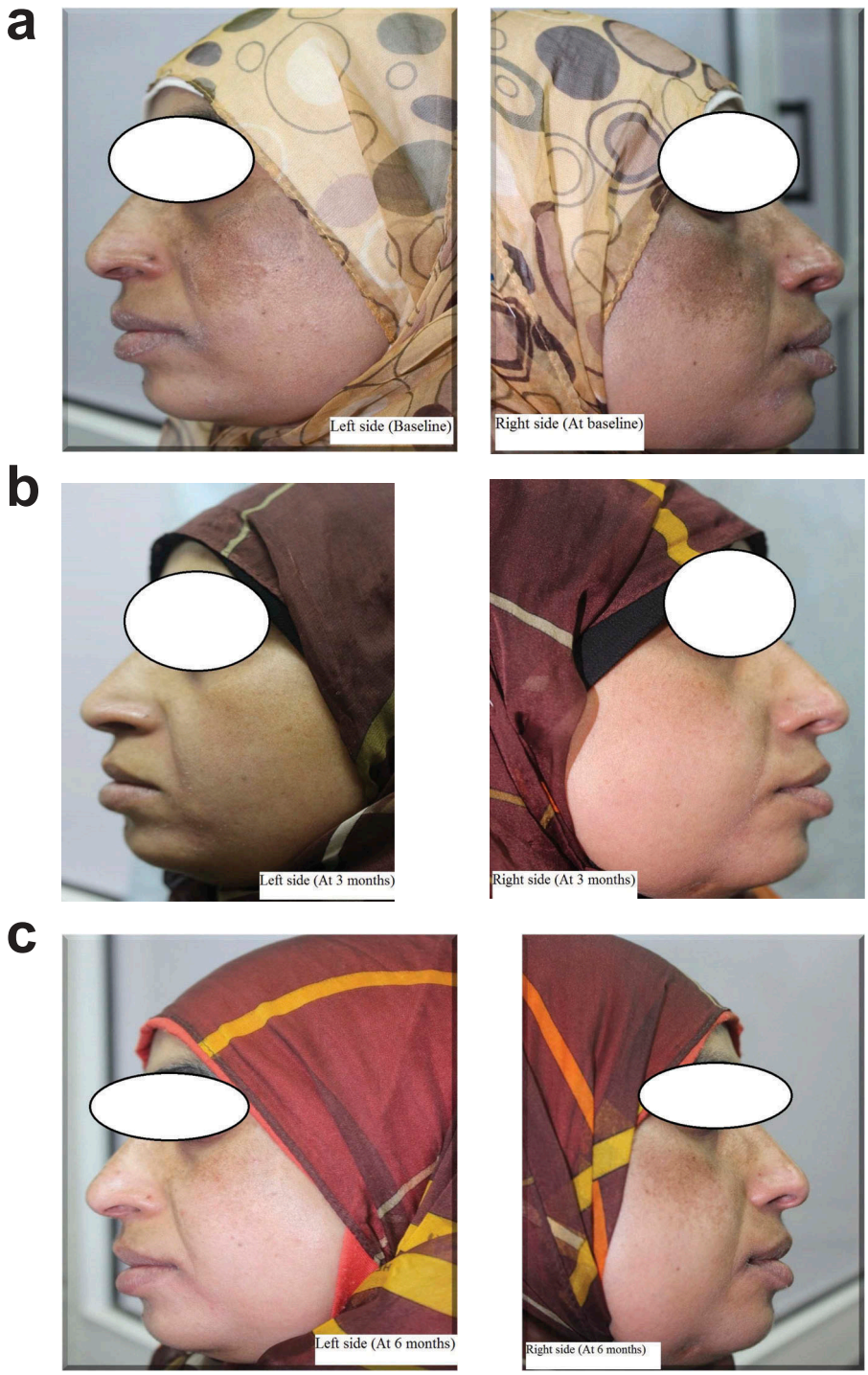

Figure 1. Significant improvement of melasma 3 months after both treatments. After 6 months follow up, recurrence was significantly higher in only hydroquinone treated side compared to hydroquinone and laser-treated side.

Table 3. Correlation coefficient between percentage of improvement and clinical parameters.

	Percentage of improvement	
	t- test	p value
Age	1.2	.2
Sex	−0.1	.9
Skin phototype	0.4	.7
Family history	1.1	.3
Duration of melasma	0.4	.7
Site of melesma	−0.3	.8
Type of melesma	1.2	.003

laser-treated side). After 6 months follow up, the mean MASI score was significantly decreased in the laser-treated side compared to non – laser-treated side which indicates that blood vessels have a possible role in the pathogenesis of melasma and vascular laser may serve an important therapeutic modality in maintaining the improvement of melasma.

The efficacy of hydroquinin has been proved as an effective therapeutic modality for the treatment of melasma (16,17), while, after reviewing the published data through a detailed

PubMed search, we did not find any research on the use of the pro-yellow laser for the treatment of melasma. The copper bromide and pulsed dye lasers were the closest vascular laser device used in the treatment of melasma.

Lee et al. (11) studied the effect of copper bromide laser in the treatment of melasma in 10 Korean women with melasma. They reported that a significant decrease in the mean MASI score after treatment, while; the expression of VEGF in keratinocytes decreased slightly. They concluded that the yellow laser may be a treatment option for melasma especially accompanied by pronounced telangiectasia.

However, another study by Hammami Ghorbel et al. (18) reported that Kligman formula combination cream is more effective than the copper bromide laser for treating melasma and recurrence occurred after both treatments. Also, they demonstrated that there is no difference in vascularization between both groups suggests that the copper bromide laser did not effectively target the vascular component of melasma. Also,; Eimpunth et al. (19) showed that the Copper Bromide Laser is not effective in improving melasma in dark-skinned phototypes patients.

Matched with our results, a split-face study on the effect of pulsed-dye laser with Kligman formula cream versus Kligman formula cream alone showed a benefit of the laser-plus-cream treatment of melasma (20). After 3 years follow up, relapse occurs in one patient spared the area previously treated with PDL, which suggests that targeting the underlying vasculature may prevent recurrence (21).

Although the efficacy of vascular-targeted laser in the treatment of melasma may be affected by intensity of sun exposure, skin phototype, and treatment techniques (19). Our study showed that there is no significant correlation between improvement of melasma after treatment and patient ages, duration of melasma, sex, skin photo-type, family history or of melasma, while there is a significant positive relation between improvement and type of melasma.

We concluded from this study that the addition of pro yellow 577-nm diode laser in the treatment of the melasma can contribute to the maintenance of improvement and delay the recurrence rate.

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