

ORIGINAL ARTICLE

## Efficacy of the 1064-nm Q-switched Nd:YAG laser in melasma

KEE SUCK SUH<sup>1</sup>, JAE YOUNG SUNG<sup>2</sup>, HYO JIN ROH<sup>1</sup>, YOUNG SEUNG JEON<sup>1</sup>,  
YANG CHE KIM<sup>2</sup> & SANG TAE KIM<sup>1</sup>

<sup>1</sup>Department of Dermatology, Kosin University College of Medicine, Busan, South Korea, and <sup>2</sup>Gorwoonsesang Dr Yang-Che Kim's Skin Clinic, Busan, South Korea

### Abstract

**Background:** Melasma is difficult to treat and often recalcitrant to various treatments such as topical preparations and lasers. **Objectives:** To evaluate the efficacy and safety of the 1064-nm Q-switched Nd:YAG laser in Asian patients with melasma. **Methods:** Twenty-three Korean patients (skin types III–V) with melasma were treated with the 1064-nm Q-switched Nd:YAG laser at 1-week intervals for 10 weeks. The melasma area and severity index (MASI) score, lightness of melasma, patient satisfaction score and side effects were assessed at baseline, 4, 7, and 10 weeks and 1, 2, and 3 months after the last treatment. **Results:** A decreased MASI score and increased lightness of melasma were statistically significant at 7 and 10 weeks. Follow-up data was statistically significant at 1, 2, and 3 months after the last treatment ( $p$ -value < 0.05). The patient satisfaction score was statistically significant at 4, 7, and 10 weeks. Follow-up data were statistically significant at 1, 2, and 3 months after the last treatment ( $p$ -value < 0.05). No significant side effects were noted. **Conclusion:** The 1064-nm Q-switched Nd:YAG laser is a safe and effective modality for treating melasma in Asian patients.

**Key words:** asian, melasma, 1064-nm Q-switched Nd:YAG laser

### Introduction

Melasma is a common acquired hyperpigmentation characterized by ill-defined dark-brown macules on sun-exposed areas of the face. It is commonly observed in Asian women. Three clinical patterns of melasma are recognized: malar, centrofacial, and mandibular (1,2). Histopathologically, melasma is classified as epidermal, dermal, and mixed types (1–3). Wood's lamp examination helps to discriminate between epidermal and dermal types of melasma (1,4,5).

Various treatments for melasma, including topical agents such as hydroquinone, tretinoin and corticosteroids, and chemical peeling agents such as retinoic acid, glycolic acid, trichloroacetic acid and phenol have been used (1,2,6,7). The Q-switched ruby laser (694 nm), Q-switched alexandrite laser (755 nm), and intense pulsed light for the treatment

of melasma have been used but the results were disappointing, especially in Asian skin with mixed and dermal types of melasma (1,4,5,8,9). However, several recent studies reported that the fractional laser was effective for the treatment of melasma (10,11). The purpose of this study was to evaluate the efficacy and safety of the 1064-nm Q-switched Nd:YAG laser for treating melasma in Asian skin.

### Materials and methods

#### Patients

Twenty-three Korean women (mean age 40.95 years; range 29–53 years) with melasma were enrolled in this study after informed written consent had been obtained. The study protocol was approved by the Ethics Committee of Kosin University Gospel

Hospital. All 23 patients had Fitzpatrick skin types III–V. Patients were excluded for pregnancy, taking oral contraceptives, hormone therapy, liver dysfunction, a history of poor wound healing and keloid formation. Three months before enrolling in this study, all patients had to stop any treatment and they were instructed to apply sunscreens with a sun protection factor of 30 plus and a protection factor of UVA ++ twice daily. All 23 patients were classified into epidermal and mixed types with Wood's lamp.

#### Treatment

A 1064-nm Q-switched Nd:YAG laser (Medlite C6; Continuum Biomedical Inc., Livermore, CA, USA) was used in this study. It was used to deliver 2–4 J/cm<sup>2</sup> at 4, 6, and 8-mm spot sizes, with a pulse duration of 5–7 nanoseconds and a repetitive rate of 10 Hz for treating melasma. Fluence was adjusted by Fitzpatrick skin types and pigmentation of lesions. Patients with skin types III–IV and V received 3–4 and 2–3 J/cm<sup>2</sup>, respectively. The patients were treated weekly for 10 weeks. The duration of treatment and follow-up was from March to July 2008.

#### Melasma area and severity index (MASI)

MASI scores were evaluated by a dermatologist at baseline and at 4, 7, and 10 weeks. We followed-up patients at 1, 2, and 3 months after the last treatment. The face was divided into four areas: forehead, right malar, left malar, and chin – corresponding to 30%, 30%, 30%, and 10% of the total face, respectively (12). The severity of the melasma was decided by three variables: the percentage of total area darkness (D), homogeneity (H), and the involved area (A). The involved area (A) was classified as: 0 = no involvement; 1 = < 10% involvement; 2 = 10–29% involvement; 3 = 30–49% involvement; 4 = 50–69% involvement; 5 = 70–89% involvement; and 6 = 90–100% involvement. The darkness of the melasma (D) was rated on a scale of 0 (absent) to 4 (severe). The homogeneity of the hyperpigmentation (H) was rated on a scale of 0 (absent) to 4 (severe). The MASI score

was calculated by the following method: MASI score = 0.3 (D+H)A + 0.3 (D+H)A + 0.3 (D+H)A + 0.1 (D+H)A, corresponding to the forehead, right malar, left malar, and chin, respectively.

#### Lightness of melasma

The lightness of melasma was evaluated by two blind investigators at baseline, and at 4, 7, and 10 weeks. We followed-up patients at 1, 2, and 3 months after the last treatment. The lightness was measured by a tristimulus colorimeter (Chroma Meter CR-300; Minolta Co., Japan). The colorimeter is a portable instrument with a flexible hand-held probe which can be moved easily. The measured area is 8 mm in diameter. The L\*a\*b system recommended by the Commission Internationale de l'Éclairage was used to measure the skin color, which is expressed in three dimensions (13): the L\* value (lightness) gives the relative lightness ranging from total black (L\* = 0) to total white (L\* = 100); the a\* value represents the balance between red (positive value) and green (negative value); and the b\* value represents the balance between yellow (positive value) and blue (negative value).

#### Patient satisfaction and photography

The evaluation of patient satisfaction was assessed by a 10-cm visual analogue scale from 0 (no improvement) to 10 (excellent improvement). Photographs were taken in the same position under controlled lighting conditions at baseline, and at 4, 7, and 10 weeks. Follow-up photographs were taken at 1, 2, and 3 months after the last treatment. Any adverse side effects such as erythema, hyperpigmentation, hypopigmentation and scarring were recorded.

#### Statistical analysis

Statistical analysis was used to evaluate the changes in the MASI score, lightness, and patient satisfaction before and after treatment. All analyses were

Table I. Changes of MASI score, lightness, and patient satisfaction score with 1064-nm Q-switched Nd:YAG laser treatment in women with melasma (mean ± standard deviation).

	No.	Before	4 weeks	7 weeks	10 weeks	1-month follow-up	2-month follow-up	3-month follow-up
MASI score	23	14.15 ± 1.47	12.50 ± 3.02	9.15 ± 2.74	7.57 ± 2.91	8.22 ± 2.90	8.95 ± 2.92	10.15 ± 2.70
Lightness	23	60.71 ± 2.99	60.76 ± 2.83	61.56 ± 2.52	61.95 ± 2.14	61.73 ± 2.14	61.59 ± 2.14	61.26 ± 2.52
Patient satisfaction score	23	2.11 ± 1.01	6.21 ± 1.47	7.85 ± 1.64	8.88 ± 1.18	7.53 ± 1.40	7.38 ± 1.41	7.02 ± 1.34

No. = total number of patients.

performed using computer software (SAS, version 9.1.3; SAS Institute Inc., Cary, NC, USA). Statistical significance was defined as a  $p$ -value  $< 0.05$ .

## Results

Twenty-three patients completed the study. Table I summarizes the changes in the mean MASI score, lightness, and satisfaction of the patients.

The mean MASI score after treatment decreased from  $14.15 \pm 1.47$  at baseline to  $12.50 \pm 3.02$ ,  $9.15 \pm 2.74$ , and  $7.57 \pm 2.91$  at 4, 7, and 10 weeks, respectively. Follow-up data were  $8.22 \pm 2.90$ ,  $8.95 \pm 2.92$ , and  $10.15 \pm 2.70$  at 1, 2, and 3 months after the last treatment, respectively. A decrease in the MASI score was statistically significant at 7 and 10 weeks. Follow-up data were statistically significant at 1, 2, and 3 months after the last treatment ( $p$ -value  $< 0.05$ ) (Figure 1).

The mean lightness, as measured by colorimeter, after treatment increased from  $60.71 \pm 2.99$  at baseline to  $60.76 \pm 2.83$ ,  $61.56 \pm 2.52$ , and  $61.95 \pm 2.14$  at 4, 7, and 10 weeks, respectively. Follow-up data were  $61.73 \pm 2.14$ ,  $61.59 \pm 2.14$ , and  $61.26 \pm 2.52$  at 1, 2, and 3 months after the last treatment, respectively. An increase in the lightness was statistically significant at 7 and 10 weeks. Follow-up data were statistically significant at 1, 2, and 3 months after the last treatment ( $p$ -value  $< 0.05$ ) (Figure 2).

The satisfaction score of the patients' self-assessment of melasma improved from  $2.11 \pm 1.01$  at baseline to  $6.21 \pm 1.47$ ,  $7.85 \pm 1.64$ , and  $8.88 \pm 1.18$  at 4, 7, and 10 weeks, respectively. Follow-up data were  $7.53 \pm 1.40$ ,  $7.38 \pm 1.41$ , and  $7.02 \pm 1.34$  at 1, 2, and 3 months after the last treatment, respectively. The therapeutic satisfaction was statistically significant at 4, 7, and 10 weeks. Follow-up data were statistically significant at 1, 2, and 3 months after the last treatment ( $p$ -value  $< 0.05$ ) (Figure 3).

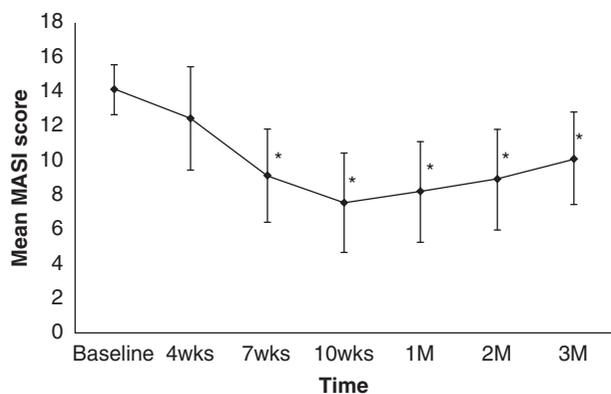


Figure 1. Results of the MASI score ( $*p < 0.05$ ; wk = week, M = month).

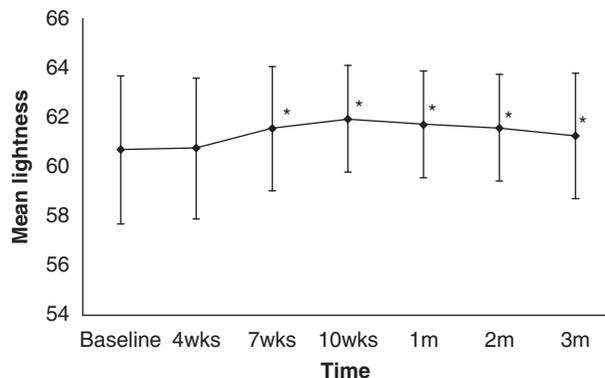


Figure 2. Lightness as measured by chromameter ( $*p < 0.05$ ; wk = week, M = month).

Changes in the mean MASI score and lightness of patients' histologic type were assessed (Tables II and III). Although epidermal-type melasma showed a better response than the mixed type, both the epidermal and mixed types of melasma were treated successfully with a 1064-nm Q-switched Nd:YAG laser (Figures 4 and 5).

In this study, clinical improvement of melasma was seen by assessment of photographs (Figures 6 and 7). The MASI score, lightness, and patients' self-assessment were correlated with clinical response. After a follow-up period of 3 months, melasma did not recur in all patients. In addition, pre-existent erythema and fine wrinkles were partially improved.

There were no serious side effects such as scarring, atrophy and infection. All patients developed mild transient erythema after each treatment lasting approximately 10–20 minutes. Prolonged erythema (3 of 23), postinflammatory hyperpigmentation (3 of 23), and postinflammatory hypopigmentation

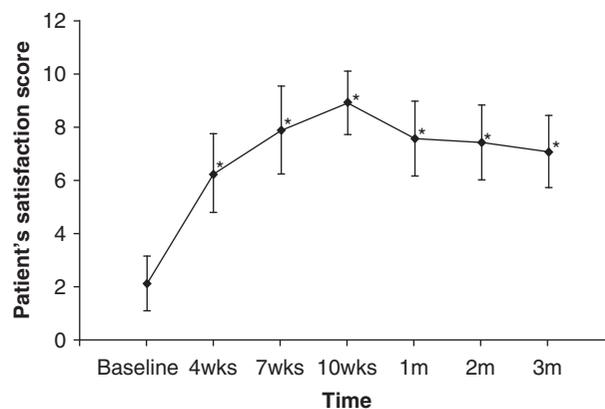


Figure 3. Patient satisfaction score ( $*p < 0.05$ ; wk = week, M = month).

Table II. Changes of MASI score with 1064-nm Q-switched Nd:YAG laser treatment in women with melasma (mean ± standard deviation).

Type	Subtype	No.	Mean MASI score						
			Baseline	4 weeks	7 weeks	10 weeks	1-month follow-up	2-month follow-up	3-month follow-up
Fitzpatrick type	III	5	12.10 ± 1.19	13.92 ± 1.73	10.9 ± 3.46	9.14 ± 3.85	9.74 ± 3.88	10.48 ± 3.92	9.68 ± 2.48
	IV	11	14.18 ± 0.57	11.98 ± 3.38	8.27 ± 2.11	6.75 ± 2.10	7.36 ± 2.08	8.12 ± 2.15	10.32 ± 2.87
	V	7	15.57 ± 0.74	12.31 ± 3.20	9.23 ± 2.83	7.73 ± 3.24	8.47 ± 3.18	9.16 ± 3.18	10.21 ± 2.95
Histologic type	Epidermal	4	13.00 ± 0.71	13.73 ± 1.63	7.66 ± 2.86	6.00 ± 2.62	6.63 ± 2.54	7.30 ± 2.41	6.95 ± 2.18
	Mixed	19	14.39 ± 1.48	12.25 ± 3.21	9.46 ± 2.69	7.90 ± 2.92	8.55 ± 2.91	9.29 ± 2.96	10.82 ± 2.32
Total		23	14.15 ± 1.47	12.50 ± 3.02	9.15 ± 2.74	7.57 ± 2.91	8.22 ± 2.90	8.95 ± 2.92	10.15 ± 2.70

No. = total number of patients.

Table III. Changes of lightness with 1064-nm Q-switched Nd:YAG laser treatment in women with melasma.

Type	Subtype	No.	Mean lightness						
			Baseline	4 weeks	7 weeks	10 weeks	1-month follow-up	2-month follow-up	3-month follow-up
Fitzpatrick type	III	5	61.84 ± 1.02	62.00 ± 1.69	62.35 ± 1.66	62.65 ± 1.58	62.46 ± 1.61	62.28 ± 1.58	62.49 ± 0.90
	IV	11	60.39 ± 3.45	60.27 ± 3.19	61.33 ± 2.60	61.84 ± 2.24	61.62 ± 2.24	61.49 ± 2.26	60.79 ± 2.55
	V	7	60.43 ± 3.29	60.66 ± 2.98	61.35 ± 3.07	61.62 ± 2.48	61.38 ± 2.45	61.24 ± 2.45	61.11 ± 3.19
Histologic type	Epidermal	4	61.68 ± 1.10	61.83 ± 1.63	62.23 ± 1.77	62.41 ± 1.60	62.19 ± 1.60	62.00 ± 1.54	62.46 ± 0.77
	Mixed	19	60.51 ± 3.23	60.54 ± 3.01	61.41 ± 2.67	61.85 ± 2.26	61.63 ± 2.26	61.50 ± 2.27	61.00 ± 2.69
Total		23	60.71 ± 2.99	60.76 ± 2.83	61.56 ± 2.52	61.95 ± 2.14	61.73 ± 2.14	61.59 ± 2.14	61.26 ± 2.52

No. = total number of patients.

(1 of 23) were noted. Prolonged erythema resolved after 3–5 days. Postinflammatory hyperpigmentation resolved after 1–2 months. Postinflammatory hypopigmentation resolved after 3 months.

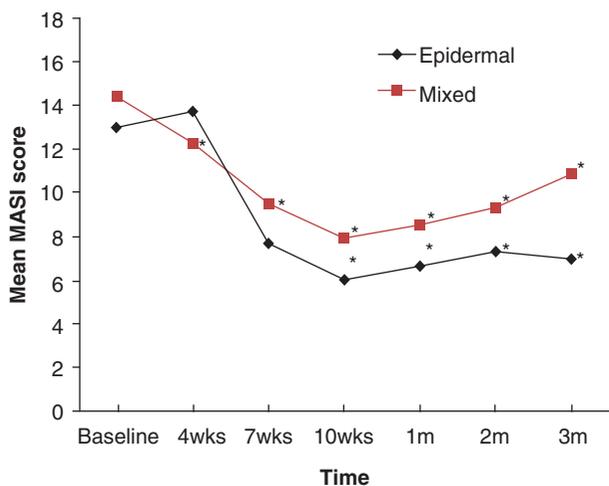


Figure 4. Results of the MASI score on histologic type (\**p* < 0.05; wk = week, M = month).

### Discussion

Melasma is commonly resistant to many treatments and causes psychological and aesthetic problems in

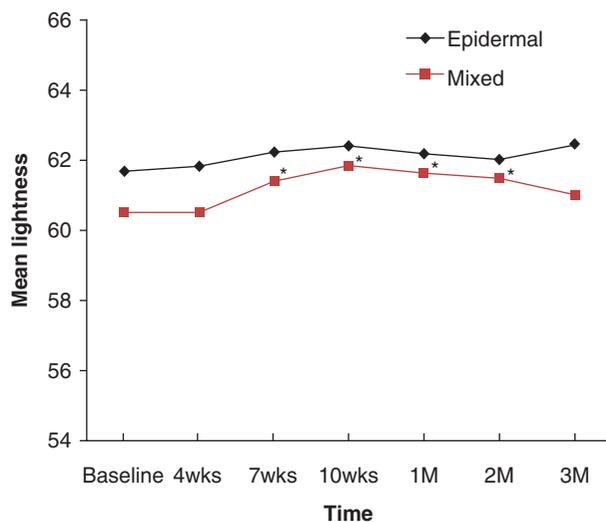


Figure 5. Lightness as measured by chromameter on histologic type (\**p* < 0.05; wk = week, M = month).

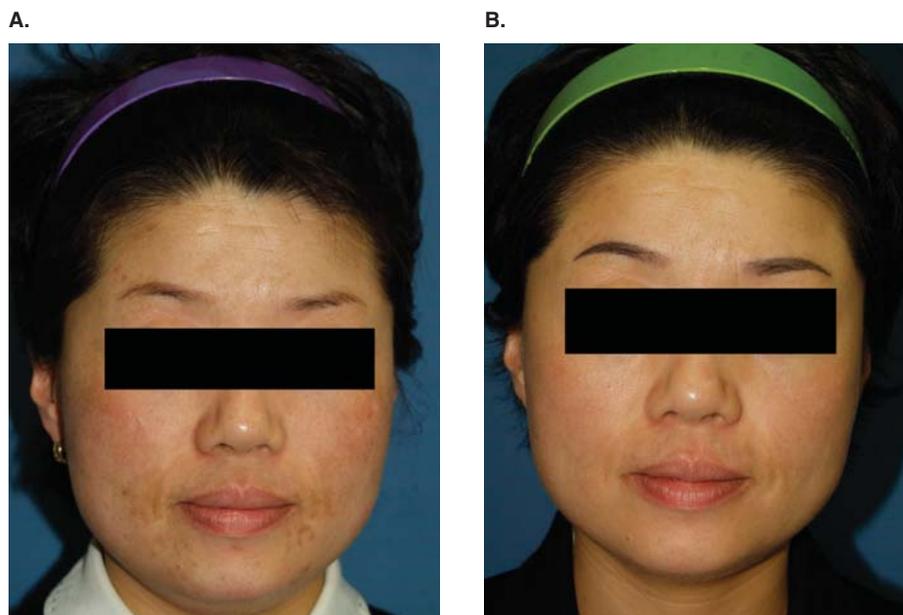


Figure 6. (A) Melasma on face before treatment. (B) Marked improvement of melasma 2 months after 10 treatment sessions.

Asian individuals. It is classified into three types: epidermal, dermal and mixed (1–3). The epidermal melasma has a good response to topical therapies such as hydroquinone, tretinoin, glycolic acid, kojic acid, frequency-doubled Nd:YAG (532 nm) laser, and intense pulsed light (1,2,6,7). However, such therapies are not effective for the dermal and mixed types of melasma that are common in Asian individuals (1,4,5,8,9).

Although there are several reports on the successful laser treatment of melasma, there are only a few

published reports on the efficacy and safety of the Q-switched Nd:YAG laser for treating melasma in dark-skinned individuals (14). The 1064-nm wavelength of the Q-switched Nd:YAG laser is able to penetrate the deep portion of the dermis and effectively treats dermal melasma resistant to chemical peelings, bleaching creams, and the Q-switched ruby (694 nm) and Q-switched alexandrite (755 nm) lasers. Therefore, dermal and mixed melasma in Asian skin should respond well to the 1064-nm wavelength of the Q-switched Nd:YAG laser.

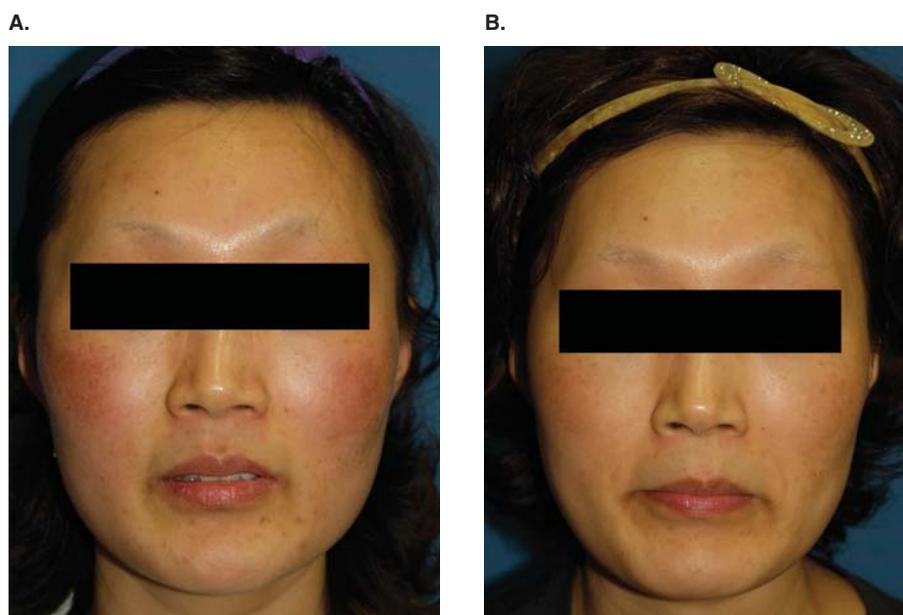


Figure 7. (A) Melasma on face before treatment. (B) Moderate improvement of melasma 1 month after 10 treatment sessions.

The Q-switched mode, which delivers an extremely high energy within approximately 10 nanoseconds, causes selective photothermolysis (8,15). The clinical advantages of selective photothermolysis are target-specific efficacy and minimal scarring. In this study, the C6 Q-switched Nd:YAG laser had two additional advantages compared with the C3 Q-switched Nd:YAG laser: a larger spot size and a flat-topped beam. The larger spot size of the C6 Q-switched Nd:YAG laser supplies increased power which can deeply transfer confluent energy to the target molecules. The flat-topped mode of the C6 Q-switched Nd:YAG laser delivers evenly to the skin surface and minimizes epidermal injury and subsequent scars. These advantages show that Q-switched Nd:YAG laser therapy effectively treats patients with dermal melasma and reduces postinflammatory hyperpigmentation.

This study demonstrated marked improvement of melasma after Q-switched Nd:YAG laser therapy once a week. The MASI score began to decrease from 4 weeks, and reduction of the MASI score was statistically significant at 7 and 10 weeks. Follow-up data were statistically significant at 1, 2, and 3 months after the last treatment. The increase in the mean lightness, as measured by chromameter, was statistically significant at 7 and 10 weeks. Follow-up data were statistically significant at 1, 2, and 3 months after the last treatment. In the assessment by patients themselves, improvement was felt after one to two sessions of treatment. Therapeutic satisfaction was statistically increased at 4 weeks and continued until 3 months after the last treatment. Patient satisfaction could be achieved faster than changes in MASI score or lightness measured by chromameter.

In conclusion, although our study comprises a small number of patients, the result demonstrated that Q-switched Nd:YAG laser therapy was safe and effective for the recalcitrant mixed-type melasma. Repeated laser treatments at certain intervals and adequate application of broad-spectrum sunscreen might prevent melasma from relapse. Further large-scale and long-term studies would be necessary to determine the mode of maintenance therapy.

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**Declaration of interest:** The authors report no conflicts of interest. The authors alone are responsible for the content and writing of the paper.

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