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ORIGINAL ARTICLE

Low-dose 1064-nm Q-switched Nd:YAG laser for the treatment of melasma

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Abstract

Background: Melasma is a common acquired pigmentary disorder which is sometimes hard to treat with conventional methods. Various kinds of modalities have been applied for the treatment of melasma but none shows constantly good results. *Objectives*: In this study, we would like to know the effect of low-dose 1064-nm Q-switched Nd:YAG laser (QSNYL) on melasma and want to evaluate the changes of skin after laser treatment. *Methods*: Twenty melasma patients were enrolled. Two regions were evaluated from each patient; a total of 40 sites. The 1064-nm QSNYL at fluences of 2.0–3.5 J/cm^2 was used to treat the whole face, including the melasma lesions. The fluence was adjusted individually and increased until erythema was developed on the laser-treated area. The treatment was performed five times with a 1-week interval. Non-invasive measuring methods, including a chromatometer, mexameter, cutometer, visioscan and a corneometer, were used before and after treatment. *Results*: The L-value from the chromatometer, which reflects the lightness of skin, was increased (0.86 ± 1.67, $p < 0.05$). The melanin index from the mexameter was significantly decreased (-28.23 ± 28.21, $p < 0.001$). The SEw value from the visioscan, which reflects the degree of wrinkling, decreased (-5.80 ± 0.59, $p = 0.040$). None of the other measurement parameters showed significant changes. *Conclusions*: Low-dose 1064-nm QSNYL appears to be an effective treatment modality for melasma.

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

Introduction

Melasma is a common acquired brown or grayish-brown facial hypermelanosis, involving the cheek, forehead, upper lip, nose, and chin. Melasma have significant emotional, social, and psychological impacts on quality of life and it is notorious for its recalcitrance to the various treatments (1,2). Well-known conventional treatments of melasma include bleaching agents such as hydroquinone and tretinoin, and chemical peels with additional sunscreen usage (1,3,4). In the past, some lasers, such as the Q-switched ruby laser, have been used, but the results were disappointing due to side effects such as hyper- or hypo-pigmentation (5–7). The low-dose 1064-nm Q-switched Nd:YAG laser (QSNYL) has been used for the treatment of melasma in Asian people but, to the best of our knowledge, the objective data about the clinical results have rarely been published. This study was undertaken to evaluate the efficacy of low-dose QSNYL treatment of melasma and the changes in skin parameters after laser treatment measured by various non-invasive methods.

Materials and methods

A total of 20 facial melasma patients older than 30 years (19 females, one male; mean age 39.15 years) with Fitzpatrick skin types 3–4 were enrolled in this study. Those patients with a systemic illness or psychological disorder within the last 6 months, pregnant or lactating patients, or women taking birth control pills were excluded. It was ensured that no patients

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had been using bleaching agents or cosmetics or receiving any kind of treatment for their melasma within the last year.

A 1064-nm QSNYL (MedLite® C6; HOYA ConBio, CA, USA) was used for the treatment of melasma. A fluence of 2.0–3.5 J/cm^2, spot size of 6 mm, and a repetition rate of 10 Hz was used to treat the whole face, including the melasma lesions. The fluence was adjusted individually to the point where erythema developed. The treatment was performed five times at 1-week intervals and no other procedures were taken pre- or post-treatment except sunscreen usage during treatment.

Clinical and objective evaluations with various non-invasive methods were conducted at baseline and 4 weeks after the last (fifth) treatment. A total of 40 sites were assessed, with two regions from each of the 20 melasma patients evaluated. The cutometer (CT 575; Courage + Khazaka electronic GmbH, Germany), mexameter (MX18; Courage + Khazaka), corneometer (CM825; Courage + Khazaka) and chromatometer (CR-400; MINOLTA, Japan) were applied for the measurements (8). The visioscan (VC98; Courage + Khazaka) was also adopted for measurement of the degree of wrinkling (9). The paired *t*-test was used for statistical analysis and a p-value < 0.05 was regarded as statistically significant.

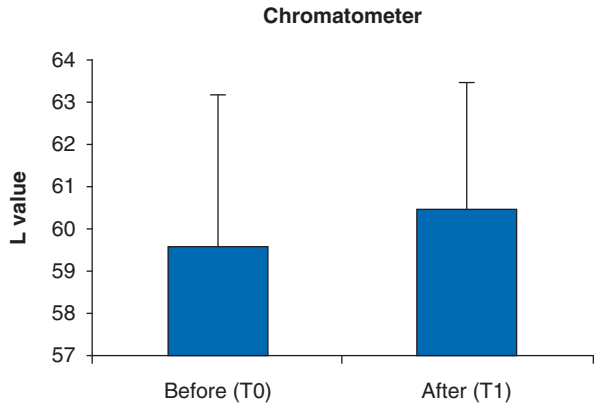


Figure 1. L-value changes using the chromatometer after low-dose 1064-nm Q-switched Nd:YAG laser treatment.

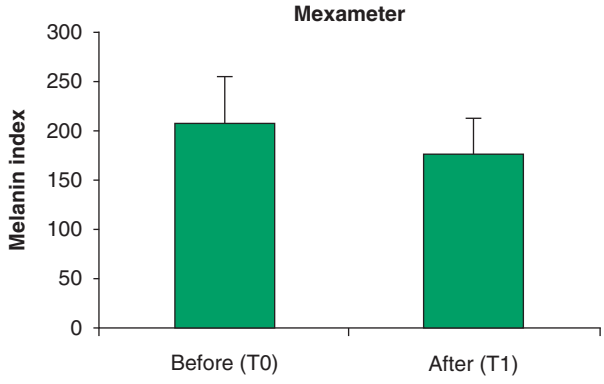


Figure 2. Changes in the melanin index using the mexameter after 1064-nm Q-switched Nd:YAG laser treatment.

Results

The L-value from the chromatometer, which reflects the lightness of skin, showed a statistically significant increase after treatment (0.86 ± 1.67, p = 0.002), meaning the skin was becoming lighter after treatment (Figure 1, Table I). Also, the melanin index of the melasma lesion measured by the mexameter showed a significant reduction after treatment (–28.23 ± 28.21, $p < 0.001$) (Figure 2, Table I). We have examined other non-invasive measurement methods, including the cutometer for the level of skin elasticity, SEw with the visioscan for the level of skin wrinkling, and the corneometer for the level of skin hydration. The values of the cutometer and corneometer increased as the skin became more elastic and hydrated. The value of SEw by visioscan is an index of skin wrinkling, so the skin becomes tighter as the value decreases. With regard to the parameters evaluated with the visioscan, there is a significant improvement

Table I. Summary of parameters of non-invasive measurements of skin before and after low-dose 1064-nm Q-switched Nd:YAG treatment.

	Before treatment (T0)	After treatment (T1)	T1–T0	p-value
L-value[a]	59.57 ± 3.63	60.43 ± 3.03	0.86 ± 1.67	0.002*
Melanin index[b]	201.69 ± 48.92	173.47 ± 33.48	–28.23 ± 28.21	< 0.001*
Cutometer value	0.9487 ± 0.0016	0.9495 ± 0.0018	–0.0008 ± 0.0016	0.914
SEw of visioscan[c]	51.72 ± 0.48	45.93 ± 0.44	–5.80 ± 0.59	0.040*
Corneometer value	74.98 ± 0.39	69.85 ± 0.53	–5.13 ± 0.59	0.065

[a]Measured by the chromatometer.
[b]Measured by the mexameter.
[c]An index of skin wrinkling by the visioscan.
*$p < 0.05$.

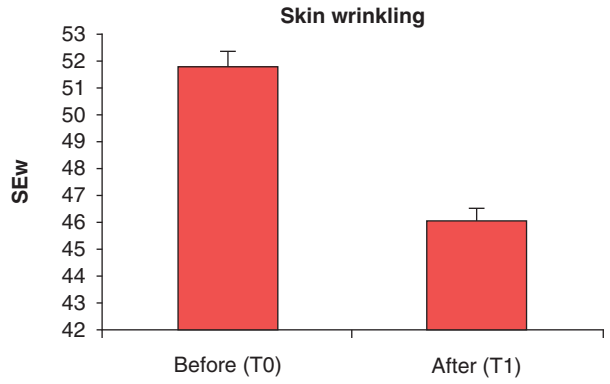


Figure 3. Changes in skin wrinkling using the visioscan after 1064-nm Q-switched Nd:YAG laser treatment.

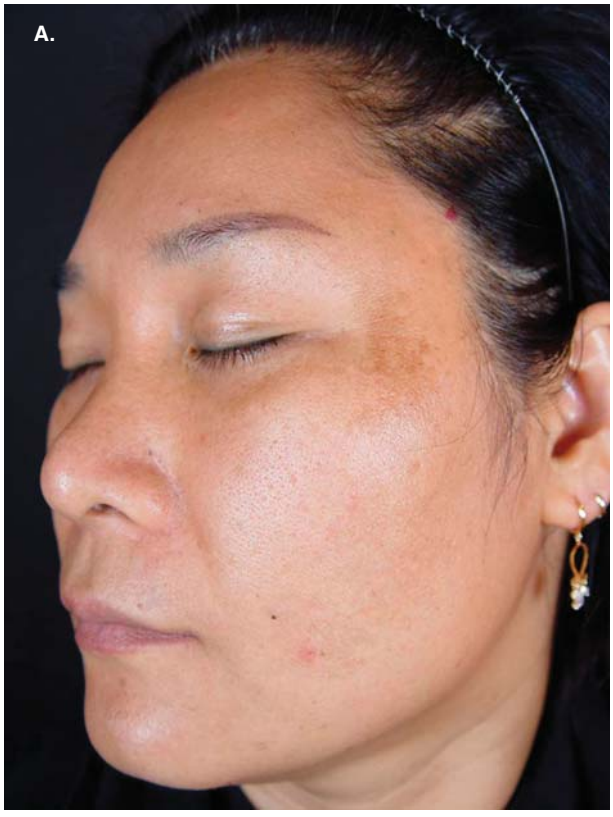
in the degree of wrinkling (number and width of wrinkles) as shown by the decreased values of the SEw parameter (–5.80 ± 0.59; Figure 3, Table I). However, we failed to show any significant effect of skin elasticity and skin hydration between the before and after treatment measurements (Table I).

All 20 patients completed five treatment sessions and all treatments were well tolerated; any complications, such as hyper- or hypopigmentation (1,5), were not noted during or after the treatments (Figure 4).

Discussion

Melasma is a common, acquired, chronic hypermelanosis, which is characterized by brown to grayish, usually symmetrical patches on the sun-exposed area of the face (1). The major etiologies including exposure to sun, genetic factors, and sex hormone were investigated as well, but the pathogenesis of melasma is not yet fully understood (1). Traditionally, melasma was classified histopathologically as epidermal, dermal and mixed type (1,8). Recently, many studies have given us a new insight on the pathogenesis of melasma; in particular, that the dermal components have an important role in the development of melasma and the tendency to relapse (1). For example, dermal inflammation induced by the accumulation of UV irradiation may be associated with the activation of fibroblasts, which result in the up-regulation of stem cell factor in melasma dermal skin leading to increased melanogenesis (10). Also interestingly, it has been suggested that increased vascularity is one of the major findings in melasma (11).

The treatment of melasma can be frustrating and often ineffective. Sunscreen usage and sun avoidance are essential and hydroquinone, azelaic acid, tretinoin, and a chemical peeling agent have been used as



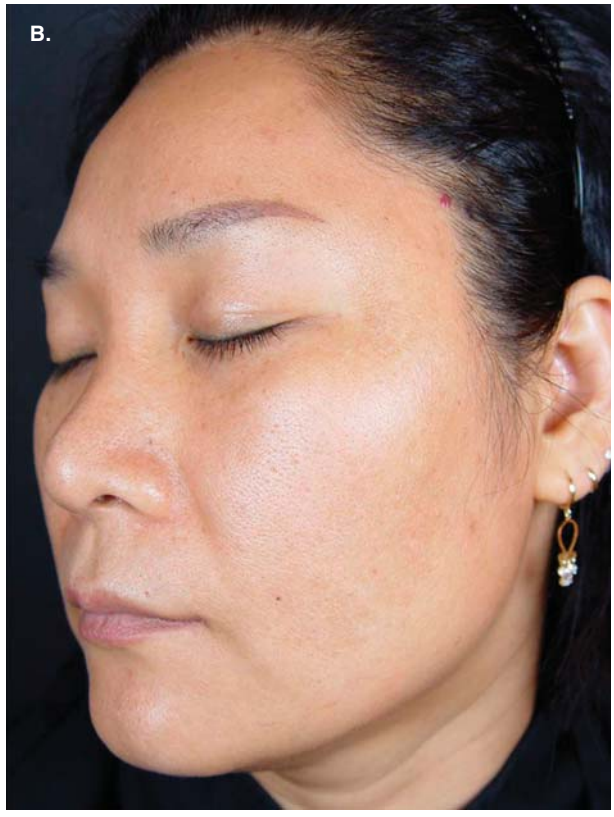


Figure 4. Patient with melasma appearing on her cheek before (A) and after five treatment sessions (B) with a low-dose 1064-nm Q-switched Nd:YAG laser. Note the improvement in pigmentation after treatment.

classical treatments (1). Over many years, there have been various laser treatments including the Q-switched alexandrite laser and Q-switched ruby laser but, unfortunately, efficacy was limited and did not show consistent results (5,12,13). Furthermore, side effects such as post-inflammatory hyperpigmentation, if it developed, are so problematic that physicians do not want to use laser treatment widely. Instead, non-ablative methods such as intense pulsed light and the low-dose Nd-YAG laser have been applied (5–7).

We used the low-dose 1064-nm QSNYL to treat melasma and evaluate the skin parameters with non-invasive measurement devices. As a result, the low-dose 1064-nm QSNYL demonstrated a good result in fading the melasma and tightening wrinkles, but other parameters – elasticity and skin hydration – did not show any good effect. The mechanism of improving melasma is still not clear, but we could explain with the hypothesis that the low-dose 1064-nm QSNYL can lead to sublethal injury to melanosomes in the melanocytes and as a result melanin granules will be fragmented and dispersed into cytoplasm (14–17). The low-dose QSNYL at 1064 nm, a wavelength well absorbed by melanin relative to other optically absorbing structures in skin, causes highly selective destruction of melanosomes (14,18). The total accumulative dose may be lower than total toxic accumulative energy that will destroy cells and this will lead to lightening of the melasma. Also, the low-dose 1064-nm QSNYL can lead to subcellular damage without cellular destruction or cell death to increased upper dermal vascular plexus, which is one of the major findings in melasma (11). In addition, the low-dose 1064-nm QSNYL is a kind of non-ablative device, so the overall energy would produce heat for a subthreshold injury to the surrounding dermis, thus encouraging the generation of collagen and resulting in brighter and tighter skin (14,15,17). Further research will be needed to define the exact mechanisms of the effectiveness of the low-dose 1064-nm QSNYL on melasma.

Previous reports have demonstrated that non-ablative laser treatment such as low-dose 1064-nm QSNYL can improve not only dyspigmentation but also overall skin status such as tones or rhytids. But our results for elasticity and skin hydration were disappointing after five weekly sessions. That might be due to laser equipment specifications or racial differences, but we should like to say that it was due to the duration of treatment. Trelles et al. (19,20) stated that long-term follow-up data show better results than the short-term in tightening and rhytid reduction; indeed, five weekly treatments (about 1 month of treatment) and a 4-week observation cannot be sufficient time to draw conclusions about the improvement of elasticity. Also, laser treatment creates minor traumatic stimulation of skin and potential thermal injury and, hence, there may be a subtle loss in skin hydration. Thus, frequent moisturizer use is recommended after laser treatment.

As people are becoming keener to improve their quality of life, cosmetic treatments such as the removal of melasma are becoming more and more popular. Accordingly, the development of new treatment modalities, which are more effective, have less downtime and fewer side effects such as postinflammatory hyperpigmentation, are urgently required. As a result, the non-ablative laser is a big trend in laser treatment. In this sense, the low-dose 1064-nm QSNYL can be one of the big players in the treatment of melasma.

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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