INTRODUCTION

Melasma is a pigmentary disorder that is characterized by poorly defined, dark brown macules on sun exposed areas, such as the face, back, and arms. This hyperpigmentation condition affects millions of people worldwide, the majority of whom are women. In the United States alone, it is estimated to affect over 6 million people, including up to 40% of the US female population. Melasma is more prominent in darker Fitzpatrick skin types III-IV, especially among Hispanic, African, and Asian populations. Those seeking treatment for the condition represent over 50% of aesthetic consultations in Asia.

Melasma is considered one of the most recalcitrant pigmentary conditions. Historically, treatment regimes such as dermabrasion, topical creams, and chemical peels have shown limited results.

Currently, Q-Switched Nd:YAG lasers provide a method of targeting both the superficial melasma, and melasma that is rooted deeper in the dermis. Many studies have been published which demonstrate Q-Switched Nd:YAG laser technology as a useful treatment modality.

The following case reports detail my personal experience using two Q-Switched Nd:YAG lasers: RevLite and MedLite lasers by ConBio, a Cynosure Company. These case reports illustrate how ConBio lasers were used as a treatment modality for melasma, and document the results of this therapy.

PATHOGENESIS

The pathogenesis of melasma is considered to be multifactorial, and may result from hormones, exposure to UV light, and/or genetics. In a normal state, dermal melanocytes are stimulated to synthesize melanin, which is then packaged in melanosomes and distributed to keratinocytes. These keratinocytes migrate to the top of the epidermis, forming a protective layer of pigmentation. However, in the case of melasma, a hyper-stimulation of the melanocytes occurs. This causes an over production of melanin, which results in brownish asymmetrical macules appearing in the skin. Depending on the depth of the melanin in the skin, melasma can be categorized as epidermal, dermal, or mixed.

BACKGROUND

Successful melasma therapy should accomplish three goals: depigmentation of the existing melanin, disruption or suspension of the biogenesis of new melanin, and prevention of environmental stimulation through sun avoidance and UV protection. Numerous treatment regimes attempting to accomplish one or more of these goals have been developed, however they have shown limited results and efficacy.

Traditional treatment therapies have consisted of depigmenting agents and biogenesis pathway blockers. Topical therapies such as hydroquinone, tretinoin, glycolic and kijic acid (chemical peels), and dermabrasions provide only temporary effectiveness in the treatment of epidermal melasma, and are even less effective for mixed and dermal melasma, where the melanin is rooted deeper in the dermis.

However, laser therapy has been shown to be very effective in treating melasma when using the correct parameters. The objective of laser treatment is to deliver the appropriate wavelength of laser energy in a sufficiently short pulse, such that the wavelength is highly absorbed by a specific target, while damage to surrounding tissues is minimized. Known as Selective Photothermolysis (SP), this theory was first discovered by Anderson and colleagues, and stipulates that the pulse duration should be shorter than the thermal relaxation time of the targeted tissue.
Thermal relaxation time is defined as the amount of time required for the target chromophore to cool by 50% through thermal conduction of its heat to surrounding tissues. SP ensures that the laser energy is contained within the target chromophore, which is sufficiently heated to destruction, while insufficient time is allowed for the energy to extend to the surrounding tissue.\(^2\)

When considering the target chromophore for treating melasma, the criteria of SP suggest that the Q-Switched Nd:YAG is the ideal laser for several reasons. First, melanosomes have an estimated thermal relaxation time of 10-100 nanoseconds.\(^3\) Q-Switched lasers are capable of emitting pulses in the nanosecond range, and can therefore effectively target melanosomes with a pulse duration that minimizes collateral damage. By causing rapid localized heating, nanosecond pulses also have the advantage of delivering photoacoustic energy, thus providing more effective clearance by further breaking down the target pigment. Second, Nd:YAG lasers emit a 1064nm wavelength. Longer wavelengths penetrate deeper into the dermis, making the 1064nm wavelength better suited to reach mixed and dermal melasma. Third, the 1064nm wavelength is well absorbed by the melanin target.\(^2\)

**METHODS**

Prior to the procedure, patients were instructed to avoid sun exposure for four weeks. On the day of treatment, patients were advised to wash thoroughly with soap and not to wear makeup. The area was cleansed with water prior to treatment. An assessment was performed by the physician, noting the category of melasma and the Fitzpatrick skin type. Treatment parameters were determined based on the assessment and on the patient’s clinical response to a test spot. The desired clinical end points were mild erythema and edema, a faint popping noise from the laser’s effect on the skin, and a feeling of warmth but not pain reported by the patient. The degree of pigmentation of the affected area was also considered when fluence settings were determined. Generally, darker pigmentation requires lower fluences, while lighter pigmentation requires higher fluences.

All skin types were initially treated with 8 mm, 2.4 J/cm\(^2\), and 10 Hz, until desired clinical response was noted, which generally happened by the third pass. At that point, the spot size was decreased to 6 mm for skin types I-IV, and fluence was adjusted to a setting between 2.8 and 3.4 J/cm\(^2\) at 10 Hz. Skin types V maintained initial treatment parameters throughout (see Table 1).

Treatments were initiated on the large anatomic regions of the face. The distance guide was in direct contact with the skin at all times, and an overlap of 10% between treated spots was maintained. The entire face (excluding upper and lower eyelids) was irradiated with the first pass, followed by additional passes in the same direction until 10 passes had been completed. 10 additional passes were then made, perpendicular to the direction of the first, so that the treated area had received a total of 20 passes: 10 passes horizontally in a lateral direction, and 10 passes vertically in an inferior direction (See Figure 1). After treatment, a cool, wet gauze was applied if the patient desired. Care was taken to insure that the skin surface was not damaged by laser energy during the treatment. The initial round consisted of 10 weekly treatments, followed by one maintenance treatment every four months to prevent reoccurrence.

For post treatment care, patients were instructed to use a cream-based alpha arbutin and Vitamin C, and a broad spectrum sunscreen (Avène\textsuperscript{TM} SPF 50+ cream).

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<tr>
<th>Skin Type</th>
<th>Initial Spot Size (mm)</th>
<th>Initial Fluence (J/cm(^2))</th>
<th>Subsequent Spot Size (mm)</th>
<th>Subsequent Fluence (J/cm(^2))</th>
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Table 1: Range of laser parameters for each session according to skin type.
Subject 1

A 39-year-old female with Fitzpatrick skin type II was affected by idiopathic melasma. The pigmentation did not improve 12 months after the use of several topicals and chemical peels.

The treatments were performed with a range of fluences depending on spot size, at a rate of 10 Hz. Initially, a spot size of 8 mm and 2.4 J/cm² was used, followed by 6 mm with a fluence ranging from 2.8 to 3.2 J/cm² for each session. She was treated for 10 sessions, scheduled one week apart.

Subject 2

A 28-year-old female with Fitzpatrick skin type II was affected by idiopathic melasma in the frontal region. She had also been treated with several topical therapies, with no appreciable results.

The treatments were performed at 10 Hz, and an initial spot size of 8 mm and 2.4 J/cm². After the desired clinical response was observed, a 6 mm spot size with 2.8 to 3.2 J/cm² was used at each session. She was treated for 10 sessions, scheduled one week apart.

Subject 3

A 36-year-old female with Fitzpatrick skin type II was affected by idiopathic melasma. She reported using several topical therapies and chemical peels for two years with no improvement.

Her treatments were performed with fluence ranging from 2.8 to 3.2 J/cm² at 10 Hz. A spot size of 8 mm and 2.4 J/cm² was used initially, followed by 6 mm with fluence ranging from 2.8 to 3.2 J/cm² at each session. She was treated for 10 sessions, scheduled one week apart.

Subject 4

A 54-year-old female with Fitzpatrick skin type IV was affected by idiopathic melasma. She had been treated with several topical therapies, with no appreciable results. She had also been treated with a CO2 laser two years prior, and experienced hyperpigmentation six months after treatment.

The treatments were performed at 10 Hz, with an initial spot size of 8 mm and 2.4 J/cm². This was followed by 6 mm and 2.8 to 3.2 J/cm² at each session. She was treated for 10 sessions, scheduled one week apart.
Subject 5

A 48-year-old female with Fitzpatrick skin type IV was affected by idiopathic melasma above her upper lip. Experienced severe hyperpigmentation which did not improve after a month of treatment with hydroquinone 4% galenic cream.

Her treatments were performed with fluences ranging from 2.4 to 3.2 J/cm² at 10 Hz. A spot size of 8 mm was used initially, with 2.4 J/cm², and was followed by 6 mm with 2.8 to 3.2 J/cm² at each session. She was treated for 10 sessions, scheduled one week apart.

RESULTS

At the conclusion of these treatments, pigmentation was assessed by both the patient and physician. Results were also analyzed photographically, by comparing before and after treatment images. Pigmentation was reduced, allowing for a clearer, more homogeneous complexion in all 5 cases presented.

DISCUSSION

Melasma is a significant skin condition affecting many people around the world. It is characterized by hypermelanosis, which is an overstimulation of melanocytes, resulting in excessive melanin. The causes of this over-stimulation have been reported to include environmental stimulants, such as sun exposure, and biological factors, such as hormones.

As discussed, laser therapy has been explored over the past twenty years as a treatment modality for melasma, and has demonstrated a marked improvement in treatment efficacy.

The Q-Switched Nd:YAG laser has proven from personal experience to be an invaluable tool for treating and managing melasma. After initial clearance of the pigmentation, maintenance treatments are recommended every four months, which minimize repigmentation by targeting stage IV melanosomes. Patients are also advised to supplement their treatments with sun block to prevent additional stimulation of melanocytes.

CONCLUSION

The RevLite Q-Switched 1064nm laser is an effective and safe modality for the treatment of melasma in patients with Fitzpatrick skin types I-V.

REFERENCES