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Melasma Treatment using a Two-step Q-switched and Long-pulsed Nd:YAG Protocol – a Case Series

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ABSTRACT

Melasma is a common acquired hyperpigmentation disorder characterized by symmetrical, irregularly shaped macules, appearing as light-brown to dark-brown patches, typically on malar areas, the forehead and chin. Despite numerous studies on melasma, the etiology of this disorder remains unknown. The treatment options that have been proposed and used include topical medications, chemical peels, oral medications, laser and light therapies and combination therapies. Patients in this case series have been treated with a 2-step protocol available on a single device. The first step addressed the pigment component and second step addressed the vascular component of melasma. Our results have shown that the two-step protocol used in this case series produces good results and high patient satisfaction without any side effects.

Key words: melasma, Q-switched 1064 nm, FRAC3.

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I. INTRODUCTION

Melasma, also occasionally referred to as chloasma, is a common acquired disorder of hyperpigmentation characterized by symmetrical, irregularly shaped macules, appearing as light-brown to dark-brown patches typically on malar areas, the forehead and chin [1]. Melasma is classified according to the melanin deposition in the skin: epidermal, dermal and mixed melasma. Epidermal melasma is the most common and is characterized by increased melanin in the epidermis; dermal melasma is characterized by increased melanin in the dermis, whereas mixed refers to a combination of epidermal and dermal melasma [2]. Although it is just a benign hyperpigmentary condition, it can adversely affect the patient's self-esteem and quality of life [3–5]. The disease is far more common in people of Hispanic and Oriental Indo-Chinese origin, who live in locations that receive high-intensity UV radiation [6]. Melasma affects females to a much greater extent than males; increases in estrogen and progesterone levels have been connected to melasma [7,8]. Despite numerous studies on melasma, the etiology of this disorder remains unknown. Because of the unclear etiopathogenesis and the recurrent and relapsing nature of the disease, the treatment of melasma is difficult and frustrating for the treating physician and the patient. There are many different treatments available, most of them targeting melanin production and few also targeting dermal blood vessels. The list of treatments that have been proposed and used include topical medications (such as hydroquinone, azelaic acid, arbutin, kojic acid, tranexamic acid, retinoids, steroids), chemical peels, oral medications (antioxidants, tranexamic acid), laser and light therapies (full-face resurfacing using CO^2 or Erbium:YAG laser, a variety of fractional ablative and non-ablative lasers, intense pulsed light (IPL) and Q-switched 1064 nm Nd:YAG laser [9], as well as combination therapies [10]. Combination treatments appear to be giving better results [11–13] than monotherapy. In this case series, the results of the proposed combinational laser therapy for melasma is presented in 4 treated patients.

II. CASES

All four patients in this case series have been treated with the same 2-step protocol. In the first step, Q-switched 1064 nm Nd:YAG (StarWalker MaQX, Fotona, Slovenia) with pulse duration of 5 ns and 6 to 8 mm spot size was used. Fluence was gradually increased throughout the 4 sessions; starting from 1.2 J/cm^2 in the first session and increasing up to 2.4 J/cm^2 in the fourth session. Three to four passes over the melasma were performed each session.

Second step, which targets the dermal vasculature, was done using the sub-millisecond FRAC3 1064 nm Nd:YAG modality of the same device (StarWalker MaQX, Fotona, Slovenia); 0.6 ms pulse with 4 mm spot size and fluence from 10 to 15 J/cm^2. Again, 3 to 4 passes were performed in this step. Four sessions with a 2 week interval between sessions were performed. Photographs were taken before the start of first treatment and 2-3 weeks after the last (fourth) treatment. Patients were asked to grade their improvement on a 5-

Point Likert scale; 1 (very dissatisfied), 2 (dissatisfied), 3 (neither dissatisfied nor satisfied), 4 (satisfied), 5 (very satisfied). Four blinded assessors were asked to order the photos in the correct sequence and then grade the photo that they chose as "after". The grading was done using 5- Point Likert scale; 1 (much worse), 2 (somewhat worse), 3 (no change/stayed the same), 4 (somewhat better), 5 (much better).

Table 1: Parameters used.

	1st step	2nd step
Laser System	StarWalker MaQX	
Wavelength	Q-switched 1064 nm	Long pulsed 1064 nm
Pulse duration	5 ns	0.6 ms
Fluence	1.2-2.4 J/ cm²	10-15 J/ cm²
Spot size	6-8 mm	4 mm
Frequency	10 z	3-4 Hz

Fig. 1: Case 1

Fig. 2: Case 2

Fig. 3: Case 3

Fig. 4: Case 4

RESULTS

All 4 patients said that they were very satisfied with the results of the treatment at the last follow-up. Four blinded assessors chose the correct order of the before and after photos and graded the improvement with either 4 (better) or 5 (much better).

Table 2: Average score by 4 blinded assessors on a 5-Point Likert scale.

Case	Score mean (range)
#1	4.25 (4-5)
#2	4.75 (4-5)
#3	4.75 (4-5)
#4	4.5 (4-5)

III. DISCUSSION

Our results have shown that the two-step protocol used in this case series produces good results and high patient satisfaction. The treatment protocol was composed of two steps: a) low fluence Q-switched Nd:YAG, which is as monotherapy commonly used in Asian population [14,15] and b) sub-millisecond FRAC3 1064 nm Nd:YAG to treat the dermal vascular component of melasma. Long pulsed and FRAC3 Nd:YAG have been previously used and shown to be effective in blood vessel removal [16–18] but was not used in the treatment of melasma to the best of our knowledge.

Excess production of melanin or an increase in the number of melanocytes in the melasma has been proven beyond doubt [1,2], but recent studies also show a significant increase of both the number and size of dermal blood vessels in skin of melasma [19,20], therefore approaches that address both pigmented and vascular components should provide best possible outcomes. The effectiveness of pigment-specific lasers is based on the theory of selective photothermolysis introduced by Anderson and Parrish [21], which states that, when a specific wavelength of

energy is delivered in a period of time shorter than the thermal relaxation time of the target chromophore, heat and injury are restricted to the target, minimizing damage to the surrounding tissue. The thermal relaxation time of melanosomes ranges from 50 to 500 ns [22,23] and around or even below 1 ms for really thin blood vessels [23]. Kong [24] showed that adding PDL to the Q-switched Nd:YAG treatment regimen in order to reduce the vascular component improves the outcome of melasma.

Melasma is one of the most common hyperpigmentation disorder worldwide, especially in darker skin types [6]. Despite numerous studies the etiology of melasma remains unknown but current research suggests it is a multifactorial condition where pathways of pigment homeostasis are disrupted in the epidermis, extracellular matrix, and dermis [25]. There is also strong evidence implicating sex hormones, pregnancy, drugs, thyroid dysfunction and sun exposure as potential triggers or causes [26–29].This case series shows our success on 4 female patients. In order to prove the benefits of treating the vascular component in melasma, further (split-case) studies with more patients are needed. The limitation of this report is also a relatively short follow-up ,since melasma relapses are common after a certain period despite proper treatments.

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