

Article

# Q-Switched 1064/532 nm Laser with Picosecond Pulse to Treat Benign Hyperpigmentations: A Single-Center Retrospective Study

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**Abstract:** (1) Benign melanoses are a frequent issue in aesthetic dermatology. Solar lentigo, ephelides, café au lait spots, and other melanoses represent a cosmetic issue for a growing number of subjects. The Q-switched 1064/532-nanometer (nm) laser may be considered the gold standard for management of these aesthetic issues. A new generation of Q-switched lasers, capable of concentrating the energy pulse in the spectrum of hundreds of picoseconds, is emerging, promising better results than previous ones. In this paper, we report the use of a Q-switched laser with a picosecond pulse to manage hypermelanoses. (2) Methods: 36 patients seeking melanoses removal were retrospectively enrolled at Magna Graecia University of Catanzaro. Treatment parameters, although variable, were the following: 1064 nm with a pulse duration of 450 picoseconds (ps) for dermic lesions and 532 nm with 370 ps for epidermal lesions. Up to four treatments, with a minimum interval between laser treatments of 30 days, were performed. After the last session, patients' satisfaction was assessed at a three-month follow up with a Visual Analogue Scale (VAS). Two blinded dermatologists measured the aesthetic outcome using a five-point scale comparing pictures before laser sessions and during follow-up. (3) Results: 36 patients were enrolled; 23 were females (63.9%) and 13 males (36.1%). The mean reported age was  $49.2 \pm 18.9$  years. All participants were assessed with a complete/almost complete melanoses removal at the dermatological evaluation, with a mean VAS score of  $9.39 \pm 0.90$ . (4) Conclusions: The Q-switched 1064/532 nm laser may be considered the main weapon in treating benign hypermelanoses. The picosecond pulse seems to guarantee better results than other devices. However, a clinical trial comparing Q-switched nanosecond pulse with picosecond pulse is necessary to confirm this study's findings.

**Keywords:** Q-switched laser; benign hyperpigmentations; melasma; solar lentigo



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## 1. Introduction

Melanoses' elimination for cosmetic reasons is a common request in aesthetic dermatology [1–4]. Hyperpigmentations can be described as the darkening of the skin secondary to melanin increasing in skin layers. Different procedures have been suggested to treat these hyperpigmentations, such as chemical ablation, hypopigmenting creams, and surgery [5]. Lasers conventionally exploited to remove exophytic lesions, such as CO<sub>2</sub> lasers, have been initially suggested using fractional modality to convey heat in the superficial layers of the skin [6,7]. These devices are unfortunately linked with scarring and hyper/hypopigmentations [8,9]. To avoid these side effects, lasers with shorter wavelengths, aiming to act exclusively on chromophores, achieve better cosmetic outcomes.

Among these lasers, various papers suggest that the Q-switched laser, releasing energies in nano or picosecond, acts selectively on melanin, and does not cause any thermal damage on the surrounding tissues. Picosecond-pulsed Q-switched lasers release energy in a minimal amount of time and appear to be the most effective therapy [10–12].

This study evaluates the safety and efficacy of hypermelanosis removal using a Q-switched picosecond 1064/532 nm laser.

## 2. Materials and Methods

All patients asking for cosmetic hypermelanosis treatment from the 1st July 2019 to the 30th December 2019 at the dermatological department of Magna Graecia University (Catanzaro, Italy) were retrospectively recruited in this study. Exclusion criteria included: hypersensitivity to light (visible and near-infrared); medication known to increase sensitivity to light; therapies with anticoagulants and/or immunosuppressants; pregnancy or nursing; personal or family history of skin cancer; sun exposure in the three weeks before treatment (for any skin type); previous hyperpigmentation removal treatment; gold-containing medication; recent exfoliation treatments, surgical treatments and past skin disorders (including keloids).

Participants were treated with a Q-switched 1064/532 nm laser system (Pico, Deka M.E.L.A., Calenzano, Italy) capable of producing ultrashort pulses to reach selective photothermolysis of melanin with no to minimal damage to neighboring structures (Figure 1). Although variable and dependent on the region of interest, type of melanosis, and skin phototype, treatment parameters were the following: 1064 nm, up to 3 J/cm<sup>2</sup> with a pulse duration of 450 picoseconds (ps) for dermic lesions and 532 nm up to 1 J/cm<sup>2</sup> and 370 ps for epidermal lesions. Laser sessions were performed at least 30 days apart or until complete recovery of the skin. The final evaluation and follow-up visit took place three months after the last procedure; the clinical endpoint was the complete disappearance of the lesion(s). All patients agreed with the risk of the procedure and signed informed consent. The study followed the laser safety guidelines ANSI Z136.3.



**Figure 1.** Figure of the Q-Switched system.

Before the first treatment and three months after the last session, physicians carried out photographic documentation. Researchers used the same camera (Nikon 5600d, Nikon Corporation, Minato City, Tokyo, Japan) and parameters, the same shooting settings, a twin flash, and the same ambient light (Figures 2–6).



Figure 2. (A) Solar Lentigo before treatment; (B) region three months after the last session.



Figure 3. (A) Multiple lentigo before treatment; (B) region three months after the last session.

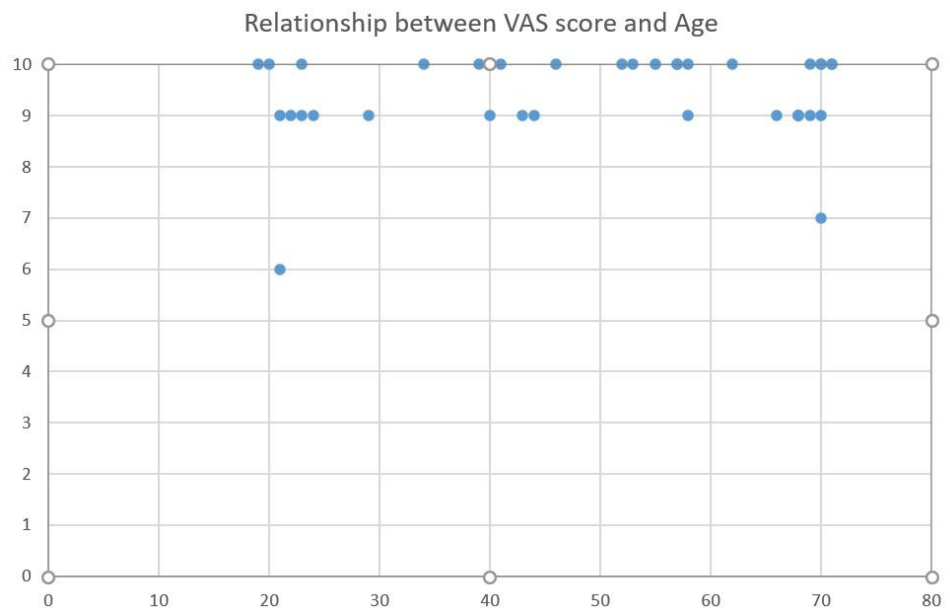


Figure 4. Relationship between VAS score and age.





**Figure 5.** (A) Solar lentigo before treatment; (B) region three months after the last session.



**Figure 6.** (A) Hypermelanosis before treatment; (B) region three months after the last session.

Two independent clinicians assessed the photographs, providing a score on a 5-point scale (0–20% removal = 0; 20–40% removal = 1; 40–60% removal = 2; 60–80% removal = 3; 80–100% removal = 4).

Participants filled out a Visual Analogue Scale (VAS) from 1 to 10 at the three-month follow-up to measure satisfaction.

Statistica 14.0 (TIBCO Software, Palo Alto, California, CA, USA) software was used for data analysis (mean, standard deviations, and rate calculations).

### 3. Results

Researchers recruited 36 participants in this retrospective study; 23 were females (63.9%) and 13 males (36.1%). The mean reported age was  $49.2 \pm 18.9$  years. Participants' skin color ranged (using the Fitzpatrick scale) from type II ( $n = 7$ ; 19.4%) to type III ( $n = 16$ ; 44.4%) and type IV ( $n = 13$ ; 36.1%). Hypermelanosis was present in the epidermis in 34 cases (94.4%); only 2 (5.6%) cases involved the dermis. Most hypermelanoses were located on the face ( $n = 33$ –91.7%), while there were only two lesions (5.6%) on the trunk and one (2.8%) on the extremities.

Researchers needed up to four sessions to complete hyperpigmentation removal, with the mean number of treatments being  $1.3 \pm 0.6$ . Melanosis can generally be safely and effectively removed in one or two sessions. Dermal lesions may instead require more treatments, up to four laser sessions.

Clinical evaluation reported the maximum score in 25 patients (69%) treated for epidermal melanosis. The mean score was  $3.61 \pm 0.60$ . Epidermal hyperpigmentations reported a score of  $3.71 \pm 0.46$ , while dermal lesions reported a score of 2, showing overall lower effectiveness in the management of dermal lesions.

The mean VAS score reported by participants was  $9.39 \pm 0.90$ ; patients treated for more superficial lesions had a higher score ( $9.57 \pm 0.56$ ) than other types of lesions. Patients' age did not seem to influence VAS score results (Figure 4).

No serious adverse event occurred; treatment was well tolerated by all patients. After laser treatment, most of the participants reported transient perilesional erythema and edema, sometimes accompanied by itching, that spontaneously resolved in 1–3 days; regular progress after treatment included treated lesions becoming darker and covered by a flake/crusty formation, which exfoliated and turned into transient hypopigmentation until complete healing (no more visible effect) within 30 days.

Patient characteristics are reported in Tables 1–3.

**Table 1.** Demographic data of included patients.

Patient No.	36
Female (%)	23 (63.9%)
Male (%)	13 (36.1%)
Mean Age $\pm$ SD [years]	49.2 $\pm$ 18.9
Age range [years]	19–76
<i>Fitzpatrick phototype:</i>	
II (%)	7 (19.4%)
III (%)	16 (44.4%)
IV (%)	13 (36.1%)
<i>Hyperpigmentation depth:</i>	
Epidermal (%)	34 (94.4%)
Dermal (%)	2 (5.6%)
<i>Hyperpigmentation location:</i>	
Face (%)	33 (91.7%)
Extremities (%)	1 (2.8%)
Upper trunk (%)	2 (5.6%)

**Table 2.** Clinical parameters and removal scores in different subgroups.

	Mean No. Sessions $\pm$ SD	No. Sessions Range	Dermatologist Evaluation	Patient VAS Score
All patients	1.3 $\pm$ 0.6	1–4	3.61 $\pm$ 0.60	9.39 $\pm$ 0.90
<i>Fitzpatrick phototype:</i>				
II	1.3 $\pm$ 0.9	1–2	3.86 $\pm$ 0.38	9.57 $\pm$ 0.53
III	1.1 $\pm$ 0.3	1–4	3.63 $\pm$ 0.72	9.25 $\pm$ 1.18
IV	1.3 $\pm$ 0.8	1–2	3.46 $\pm$ 0.52	9.46 $\pm$ 0.66
<i>Hyperpigmentation depth</i>				
Epidermal	1.2 $\pm$ 0.4	1–2	3.71 $\pm$ 0.46	9.57 $\pm$ 0.56
Dermal	3.0 $\pm$ 1.4	2–4	2	6.5 $\pm$ 0.71
<i>Hyperpigmentation location</i>				
Face	1.3 $\pm$ 0.6	1–4	3.67 $\pm$ 0.60	9.45 $\pm$ 0.90
Extremities	1.0 $\pm$ 0.0	1	3	8
Trunk	1.0 $\pm$ 0.0	1	3	9

**Table 3.** Types of melanoses removed.

Type of Treated Clinical Melanoses	Number of Patients
Solar lentigo	25
Ephelides	5
Café au lait spots	3
Linear hypermelanosis	1
Melasma	2

#### 4. Discussion

We may define hyperpigmentations as the storage of a pigment such as melanin into the skin layers. Q-Switched lasers use the photomechanical effect to destroy the targeted chromophores, having no or minimal photothermal effect on surrounding tissues [13–15]. Only hyperpigmentations not associated with the risk of degeneration in malignancies should be treated with lasers; other hypermelanotic lesions, such as dysplastic nevi, should be handled with surgery. Lesions approachable by laser therapy may be divided into epidermal pigmented lesions (such as lentigo simplex, ephelides, café au lait spots, linear hypermelanosis, Spilus, and Becker spots) and dermal pigmented lesions (such as melasma, post-inflammatory hyperpigmentation, acquired and congenital dermal melanocytosis) [16–18]. Due to the superficial distribution of melanin, all epidermal melanoses respond better to the 532 nm wavelength [19,20]. Only café au lait spots seem to have a better response at 1064 nm.

Although the 1064 wavelength usually gives better results to dermal melanosis, the outcome remains controversial in melasma, probably related to its poorly understood etiology [21–23]. Acquired hyperpigmentations seem to reach better cosmetic outcomes than their congenital ones [24–26]. Our study's findings suggest a significant efficacy of lasers in lentigo and other superficial lesions and lower phototypes. The patients reported outstanding satisfaction levels, and a very low number of treatment sessions was necessary, confirming the picosecond pulsed laser as very effective as already reported by other studies in the medical literature [18,27–29].

The limitations of our study include the small number of recruited patients, the lack of digital skin analysis devices (that could have better-quantified melanoses' removal), and histologic analysis.

Our study confirms the results obtained with other picosecond pulse Q-switched lasers, showing outstanding results for hyperpigmentation management. In our cohort of participants, lighter phototypes and superficial melanosis responded better to the treatment. In comparison, darker phototypes and deeper lesions responded worse to laser therapy, and an augmented number of sessions was necessary. Patients signaled only minor side effects such as superficial crusting. A randomized trial comparing nanosecond and picosecond pulsed range Q-switched lasers with a significant number of patients will be necessary to confirm this study's findings. Although, our data broadly agree with previous, both simulated and in vivo, studies that suggest the picosecond laser to be the more effective modality, as lower pulse duration should improve results by selectively targeting the melanin in the hyperpigmented lesions [30,31].

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