TREATMENT OUTCOMES OF MELASMA USING PICOSECOND ND: YAG 1064NM LASER AT CAN THO DERMATOLOGY HOSPITAL

Thanh Lam[1], Sang Huynh Van[1], Lac Thi Kim Ngan[2], Nguyen Ngoc Kim Ngan[3], Hung Gia Tran[2*]

ABSTRACT

Objective: To evaluate the efficacy of the picosecond Nd:YAG 1064 nm laser in treating melasma at Can Tho Dermatology Hospital from 2024 to 2025. **Research object and Method**: A cross-sectional study was conducted on 55 patients diagnosed with melasma at the Can Tho Dermatology Hospital from July 2024 to May 2025. Melasma was evaluated using the Melasma Area and Severity Index (MASI) score, varied from 0 to 48, of which mild level < 5.5, average > 5.5 - < 8.7, heavy > 8.7 - < 13.1, very heavy > 13.1 – 48. Clinical improvement was assessed every 4 weeks (re-examination and subsequent treatment) at 4, 8, 12, 16, and 20 weeks. **Results**: The mean Melasma Area and Severity Index (MASI) score decreased progressively. At baseline (T0), the mean MASI score was 10.49 ± 2.49. After 4 weeks (T1), it reduced to 8.80 ± 2.56, followed by 7.07 ± 2.14 at 8 weeks (T2), 5.76 ± 1.61 at 12 weeks (T3), 4.40 ± 1.21 at 16 weeks (T4), and 3.26 ± 0.70 at 20 weeks (T5). These reductions were statistically significant ($p < 0.01$). The most common side effects at T5 were transient tingling (45.5%), dry skin (36.4%), pruritus (36.4%), and erythema (36.4%), all of which resolved spontaneously. The incidence of new lesions decreased over time, and no new lesions were reported at T5. **Conclusion**: These findings suggest that picosecond Nd:YAG 1064 nm laser demonstrated high efficacy and safety in treating melasma, with significant reductions in MASI scores, improved clinical severity, and minimal transient side effects.

Keyword: *melasma, picosecond laser, Nd:YAG 1064nm laser, MASI*

[1]*Can Tho University of Medicine and Pharmacy*
[2]*Department of Dermato-Venereology, Faculty of Medicine, Can Tho University of Medicine and Pharmacy*
[3]*Hong Bang International University*
Responsible person: Hung Gia Tran
Email: tghung@ctump.edu.vn
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I. INTRODUCTION

Melasma is a chronic acquired pigmentary disorder that primarily affects aesthetic appearance, causing greater psychological distress in women than in men. It is characterized by well-demarcated hyperpigmented patches, ranging from light brown to dark brown or grayish-brown, predominantly on the face, particularly the cheeks. Although melasma does not significantly affect physical health, it can negatively affect patients' psychological well-being and quality of life [1], [2].

The pathogenesis of melasma is a complex and multifactorial process that has not yet been fully elucidated. It involves an intricate interplay between genetic predispositions, environmental factors, and cellular signalling cascades. Ultraviolet radiation (UVR) is a well-established primary exogenous trigger that exacerbates existing lesions and promotes de novo hyperpigmentation, particularly in photo-exposed anatomical regions. This is attributed to UVR-induced melanogenesis and potential damage to the dermal-epidermal junctions. Endogenous factors, particularly hormonal fluctuations, have been

strongly implicated. Estrogen, which is often elevated during gestation or with oral contraceptive use, is a significant contributor to melasma pathogenesis. Estrogen exerts its effects on melanocytes, stimulating increased melanin synthesis and its subsequent transfer to keratinocytes, leading to characteristic epidermal hyperpigmentation. Beyond melanocytes, emerging research indicates that other dermal components, including fibroblasts, mast cells, and altered vascularity, also contribute to the complex pathophysiology of this challenging pigmentary disorder [3], [4], [5], [6].

Various treatment modalities exist for melasma; however, treatment is challenging, time-consuming, and rarely results in complete resolution. Monotherapy often yields limited efficacy, requires prolonged treatment, and incurs high costs, leading to patient frustration and treatment discontinuation [1], [2]. Therefore, a multimodal approach combining oral medications, topical treatments, sun protection, advanced technologies, and lifestyle modifications is essential to optimize outcomes and minimize side effects. The picosecond (Pico) Nd:YAG 1064 nm laser addresses these needs by selectively targeting skin pigments and fragmenting them into smaller particles with low-energy settings, achieving effective treatment with fewer side effects. Nd:YAG lasers leverage selective photothermolysis, specifically targeting melanin as a chromophore to induce precise thermal damage and subsequent clearance of pigmented dermatological lesions while preserving adnexal structures and adjacent dermal architecture [7], [8]. The 1064 nm Q-switched Nd:YAG laser is indicated for conditions such as melasma, nevus of Ota, and Hori's nevus. However, its efficacy is diminished in darker skin phototypes, and post-inflammatory hyperpigmentation (PIH) outcomes are inconsistent, precluding its recommendation [8]. Furthermore, treatment is associated with a high incidence of dyspigmentation (hyper- or hypopigmentation) and significant recurrence rates, necessitating multiple treatment sessions [7]. The advent of Picosecond Nd:YAG lasers (532 nm, 755 nm, and 1064 nm) delivering pulse energies up to 400 mJ with ultrashort pulse durations (450ps) offers enhanced pigment fragmentation via photoacoustic effects. This reduced pulse duration minimizes collateral thermal damage to the perilesional tissue, thereby mitigating adverse events commonly observed with nanosecond systems and improving overall treatment safety and efficacy [9], [10].

While international studies have evaluated the efficacy of the Pico Nd:YAG 1064 nm laser for melasma, research in Vietnam remains limited. Thus, we conducted the study “Treatment Outcomes of Melasma Using Pico Nd:YAG 1064 nm Laser at Can Tho Dermatology Hospital, 2024–2025” to evaluate its efficacy.

II. RESEARCH OBJECT AND METHOD

2.1. Research object

The study included all patients diagnosed with melasma at the Can Tho Dermatology Hospital. Patients diagnosed with melasma were recruited for Pico Nd:YAG 1064 nm laser treatment. Eligible participants were 18 years or older, without severe medical or malignant conditions, and agreed to participate in the study.

The exclusion criteria were as follows: pregnant women, patients with photosensitive skin, those unable to avoid sun exposure owing to occupational conditions, and those allergic to topical anesthetics or study-related topical agents.

2.2. Material and methods

This was a cross-sectional study. The sample size was estimated using the formula for population proportion estimation: $n = Z^2_{(1-\alpha/2)} \frac{p(1-p)}{d^2}$ where α = 0.05 (level of statistical significance), Z (1- a/2) is the corresponding Z- score, p = 0.948, based on a study by Le Thi Thu Hai (2020), which reported that 94.8% of melasma cases treated with Pico Nd:YAG 1064nm achieved improvement, and d = 0.06 (margin of error) [11]. Using this formula, the required sample size was 52.6; however, 55 samples were collected.

Patients were treated with a Pico Nd:YAG 1064 nm laser. A 2019 USA-manufactured Picosecond Laser System was used. Baseline photographs were taken prior to treatment. Pico Nd:YAG 1064nm laser was utilized with a 7mm spot size at 1.2-1.9 J/cm2. Melasma lesions were treated in three passes, ensuring an approximate 50% beam overlap. Immediate post-treatment involved cooling and photography, followed by standard aftercare and scheduled follow-ups. They were re-examined, subsequently treated with laser, and assessed for clinical improvement at 4, 8, 12, 16, and 20 weeks.

2.3. Data collection

The study collected demographic data, including age, sex, and clinical characteristics, including distribution pattern forms and severity of melasma, treatment efficacy over time according to the severity scores of the disease, incidence of new lesions, and side effects.

The clinical characteristics of melasma were assessed using the Melasma Area Severity Index (MASI) scale. The MASI was developed by Kimbrough Green et al. and is widely and specifically applied in the "Guiding Protocol for Clinical Trials of Melasma" to measure the degree of melasma [12]. The evaluation of treatment outcomes consisted of the level of mean MASI change, occurrence of new lesions over time at follow-up, and side effects.

2.4. Statistical analysis

Data were managed and analyzed using SPSS 27.0.

III. RESULTS

3.1. Characteristics of the participants

Table 1. ***Demographic data of the participants***

General characteristics (n=55)	
Age	
Average age	42.47±8.17
<30	4.5%
≥30	95.5%
Gender	
Female	100%

The study included 55 participants with an average age of 42.47 ± 8.17 years. The majority were ≥ 30 years old (95.5%), and 100% of the patients participating in the study were female.

3.2. Clinical Characteristics of Melasma

Table 2. ***Distribution of Patients according to Distribution patterns and Severity of Disease***

Clinical characteristics	Frequency (n)	Percentage (%)
Distribution patterns		
Centro-facial	5	9.1
Malar (butterfly-shaped)	41	74.5
Indeterminate	9	16.4
Severity according to MASI		
Mild	1	1.8
Moderate	10	18.2
Severe	34	61.8
Very severe	10	18.2

Among the patients enrolled in the study, 74.5% presented with the malar pattern (butterfly shaped pattern), 9.1% with the centro-facial pattern, and 16.4% had mixed or indeterminate forms. Most patients were classified as having severe melasma (61.8%, 34 cases). The very severe and moderate groups each accounted for 18.2% (10 cases), whereas only one patient (1.8%) was categorized as having mild melasma. The mean Melasma Area and Severity Index (MASI) score was 10.49 ± 2.49.

3.3. Mean MASI Score Over Time

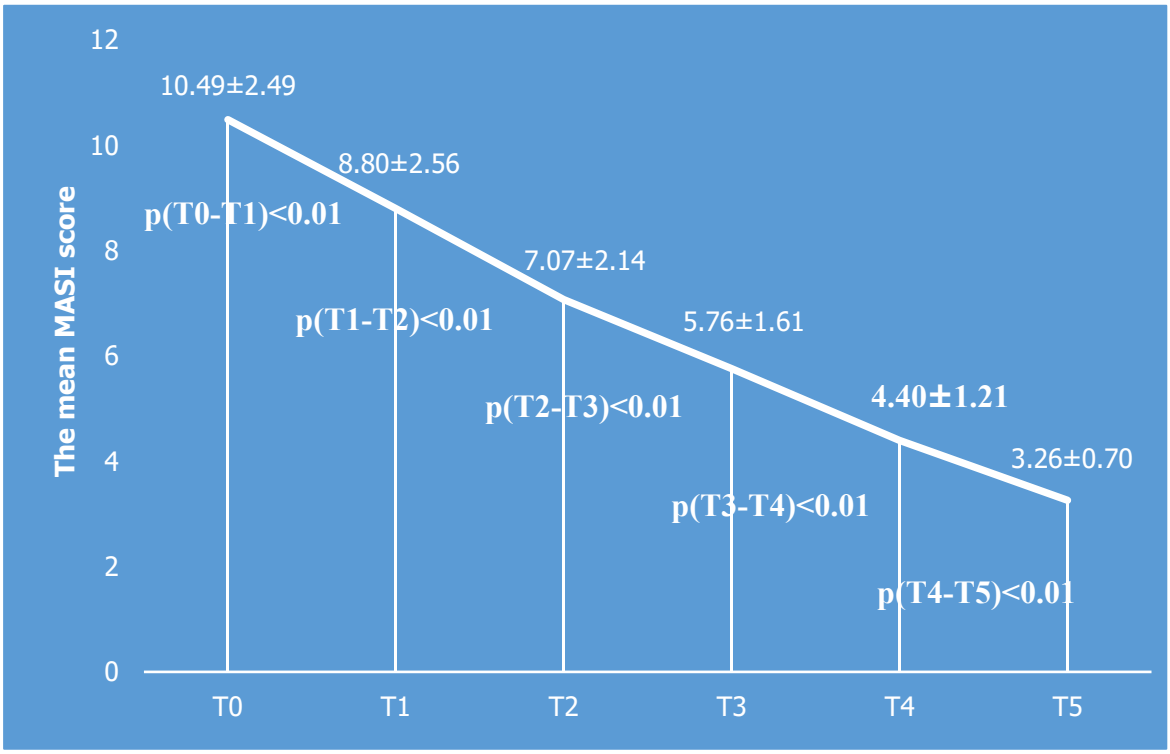

Figure 1. ***MASI Scores Over Treatment Duration***

The mean MASI score showed a significant progressive decline from T0 to T5. At baseline (T0), the mean MASI score was 10.49 ± 2.49. After 4 weeks (T1), it decreased to 8.80 ± 2.56, followed by 7.07 ± 2.14 at 8 weeks (T2), 5.76 ± 1.61 at 12 weeks (T3), 4.40 ± 1.21 at 16 weeks (T4), and 3.26 ± 0.70 at 20 weeks (T5). The differences between the time points were statistically significant ($p < 0.01$).

3.4. Incidence of New Lesions

Table 3. ***Distribution of Patients by Incidence of New Lesions***

New lesions	T1 (n,%)	T2 (n,%)	T3 (n,%)	T4 (n,%)	T5 (n,%)
Yes	13 (23.6)	6 (10.9)	5 (9.1)	2 (7.7)	0 (0)
No	42 (76.4)	49 (89.1)	39 (80.9)	24 (92.3)	11 (100)
Total	55 (100)	55 (100)	44 (100)	26 (100)	11 (100)
p	$p_{(T1-T2)}$=0.09	$p_{(T2-T3)}$=0.705	$p_{(T3-T4)}$=0.564	$p_{(T4-T5)}$=0.317	

The proportion of patients with new lesions decreased with time. At T1, 23.6% (13 patients) had new lesions, which reduced to 10.9% at T2, 9.1% at T3, 7.7% at T4, and 0% at T5. The differences in the incidence of new lesions were not statistically significant ($p > 0.05$).

3.4. Side Effects

Table 4. ***Distribution of Patients by Side Effects***

Side effects	T1 (n=55,%)	T2 (n=55,%)	T3 (n=44,%)	T4 (n=26,%)	T5 (n=11,%)
Burning sensation	13 (23.6)	8 (14.5)	14 (31.8)	3 (11.5)	1 (9.1)
Tingling	33 (60.0)	24 (61.8)	17 (38.6)	10 (38.5)	5 (45.5)
Itching	14 (25.5)	6 (10.9)	21 (47.7)	8 (30.8)	4 (36.4)
Edema	7 (12.7)	4 (7.3)	0 (0)	1 (3.8)	0 (0)
Erythema	27 (49.1)	17 (30.9)	22 (50.0)	9 (34.6)	4 (36.4)
Dry skin	14 (25.5)	19 (34.5)	13 (29.5)	8 (30.8)	4 (36.4)
Scaling	1 (1.8)	5 (9.1)	3 (6.8)	6 (23.1)	2 (18.2)
Blistering	4 (7.3)	3 (5.5)	1 (2.3)	0 (0)	0 (0)

The most common side effect was tingling, reported by 60.0% of patients at T1 and persisting in 45.5% at T5. Erythema was also common, affecting 49.1% at T1, peaking at 50.0% at T3, and reducing to 36.4% at T5. Other side effects included pruritus (25.5% at T1, peaking at 47.7% at T3) and dry skin (25.5% at T1, increasing to 36.4% at T5). All side effects were mild to moderate, transient, and did not disrupt the treatment.

IV. DISCUSSION

The mean age of the participants was 42.47 ± 8.17 years, which is consistent with previous findings. For example, a study by Le Thi Thu Hai et al. reported a mean age of 42.4 ± 5.42 years [11], while Le Thai Van Thanh (2023) found a mean age of 44.3 ± 6.7 years among pregnant women with melasma [13]. Foreign studies have corroborated that melasma predominantly affects patients aged > 30 years. For instance, Fabi et al. (2014) reported a mean patient age of 43.4 years [14]. Similarly, Choi et al. (2018) observed a mean age of 50±11 years (range 28-82) among 40 melasma patients [15]. Lee Sun Jae et al. (2023) also noted that the majority of their melasma cohort was over 30 years old, with only 12.6% being younger [16]. Furthermore, a study by Liang et al. (2019) on melasma patients treated with a 1064 nm Pico Nd:YAG laser indicated a mean age of 37.8 years [17]. These findings consistently suggest a higher prevalence of melasma in middle-aged and older adults. This age group, with heightened social interaction and aesthetic focus, often has the means to seek treatment. Dermatological literature indicates that cumulative solar exposure and oxidative stress are key age-related factors in the pathogenesis of melasma. Prolonged sun

exposure damages the basement membrane, promoting melanogenesis and elastosis. Recent research has highlighted oxidative stress, with elevated activity of enzymes such as Superoxide Dismutase and Glutathione Peroxidase in patients with melasma, activities that accumulate with age, potentially initiating or worsening the condition [18].

In our cohort, 100% of the patients were female, which aligns with the findings of prior studies by Le Thai Van Thanh (2023) [13] and Quach Thi Bay (2024) [19], both of which reported an entirely female patient population. This gender distribution may be explained by the fact that women generally show greater concern for aesthetic issues, particularly in middle age, when signs of skin aging, including melasma, become more pronounced. Melasma exhibits marked female predominance, particularly among those of reproductive age, with sex hormones being a pivotal etiological factor. Estrogen, especially during pregnancy or oral contraceptive use, exacerbates melasma by upregulating melanocytic estrogen receptors in the lesional skin, thereby enhancing pigment production. In men, melasma is more commonly associated with excessive photodamage or occupational exposure. Studies have consistently reported a male prevalence of approximately 10% of total melasma cases, although this can vary by ethnicity [17]. For instance, Choi et al. (2018) found a female-to-male ratio of 5.7:1 (34/6) [15], while Kato et Our findings align with these prior investigations, reinforcing the overwhelming female predilection for melasma.

In terms of clinical presentation, most patients in our study exhibited a malar (butterfly shaped) pattern of melasma, with 41 cases (74.5%). The centrofacial type was observed in five patients (9.1%), while nine patients (16.4%) presented with mixed or indeterminate patterns. These findings are comparable to those of Le Thi Thu Hai et al. at the 108 Central Military Hospital (2020), where the malar type was predominant (91.4%), followed by the centro-facial type (8.6%) [11]. The malar region, including the cheeks and nasal bridge, is more exposed to ultraviolet radiation, which may explain the higher prevalence of melasma in this area.

Regarding disease severity, we used the Melasma Area and Severity Index (MASI), which is considered one of the most accurate and comprehensive tools for assessing the severity of hyperpigmentation. Our findings indicated that the majority of patients were classified as having severe melasma, comprising 61.8% (34 cases). The very severe and moderate groups each accounted for 18.2% (10 cases), whereas only one patient (1.8%) was classified as having mild melasma. The mean MASI score was 10.49 ± 2.49. These results are consistent with those reported by Le Thi Thu Hai (2020) [11] and Le Thai Van Thanh (2023) [13]. Compared to international studies, our cohort demonstrated higher severity. For instance, Gokalp et al. (2016) reported a mean pretreatment MASI score of 6.7 ± 3.3 [20], while Choi et al. (2018) found a mean MASI score of 3.19 ± 2.64, indicative of mild severity [21]. However, our results showed lower MASI scores than those in the study by Liang et al. (2023), in which the mean pretreatment MASI score was 15.6 [22]. Notably, the more extensive the facial involvement, the greater the aesthetic impact, and the more challenging the treatment.

Our study demonstrated a clear trend of clinical improvement over the treatment

period. Regarding MASI scores, the mean score decreased consistently across time points: from 10.49 ± 2.49 at T0 to 8.80 ± 2.56 at T1, 7.07 ± 2.14 at T2, 5.76 ± 1.61 at T3, 4.40 ± 1.21 at T4, and 3.26 ± 0.70 at T5. The differences were statistically significant ($p < 0.01$ for T0–T1, T1–T2, T2–T3, and T4–T5; $p < 0.046$ for T3–T4). This confirms the progressive efficacy of the treatment, particularly between T1 and T4.

Our findings are supported by comparative studies. Le Thai Van Thanh et al. (2023) reported a mean MASI score reduction from 14.6 ± 6.9 to 6.6 ± 4.3, with statistically significant changes ($p < 0.001$) [13]. Le Thi Thu Hai et al. noted a MASI score reduction from 12.17 ± 4.43 to 8.22 ± 4.37 after 12 sessions [11]. Kim Dong Gyu et al. (2020) reported a MASI score reduction from 5.1 ± 1.4 to 2.6 ± 0.4 after two months ($p < 0.05$) [23]. Variations in the results may stem from differences in patient characteristics, such as lesion severity, age, skin type, lesion location, treatment techniques, and protocols. Nonetheless, all studies consistently demonstrate high treatment success rates, with better outcomes associated with more treatment sessions than fewer.

The proportion of patients who developed new lesions decreased progressively over the course of treatment. At T1, 13 patients (23.6%) exhibited new lesions. This rate declined to 10.9% at T2, followed by a slight decrease at T3 (9.1%) and T4 (7.7%). Conversely, the proportion of patients without new lesions increased markedly from 76.4% at T1 to 100% at T5 was observed. No statistically significant differences were observed in the appearance of new lesions across the treatment time points ($p > 0.05$), with specific p-values as follows: p(T1–T2) = 0.09; p(T2–T3) = 0.705; p(T3–T4) = 0.564; and p(T4–T5) = 0.317. These findings indicate that, although there was a clear clinical trend toward improvement, the reduction in new lesion development did not reach statistical significance in this study. According to a study by Luu Truc Linh et al. (2023), the majority of patients did not develop new lesions after 16 weeks of treatment, with only 10.5% experiencing new lesion formation [24]. However, a long-term study by Gokalp et al. (2016) reported a high recurrence rate for melasma post-treatment, with 20 out of 34 patients (58.8%) experiencing recurrence one year after treatment completion [20].

The most common side effect was tingling (60.0% at T1 and 45.5% at T5), followed by erythema (49.1% at T1 and 36.4% at T5). Itching and dry skin increased to 36.4% by T5. These side effects were mild to moderate, transient, and did not disrupt the treatment. No post-inflammatory hyperpigmentation or hypopigmentation was observed in any of the treated patients. Le Thi Thu Hai et al. reported only 3.4% of patients with a burning sensation and no other side effects [11]. Kim Dong Gyu et al. (2020) noted erythema (n=1) and edema (n=1) without post-inflammatory hypo- or hyperpigmentation [23]. Liang S et al. (2023) reported 5% of patients with post-inflammatory hyperpigmentation [22]. Common post-treatment sensations include burning, tingling, or itching, typically resolving within 30–60 min, with erythema also frequently observed. Less common side effects include edema, scaling and blistering.

V. CONCLUSION

This study demonstrates that the picosecond Nd:YAG 1064 nm laser is an

effective treatment for melasma, significantly improving the MASI scores and clinical severity over time. After 20 weeks, all patients achieved the highest level of clinical improvement with no new lesions reported. Common side effects, including tingling, erythema, dry skin, and itching, were mild and transient and did not affect treatment continuation. This method is safe, with minimal complications, and shows promise for widespread clinical application in the future. However, to maintain treatment efficacy and prevent recurrence, sun protection, lifestyle modifications, and adherence to post-treatment skincare are crucial.

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