Lasers in Medical Science (2025) 40:72
https://doi.org/10.1007/s10103-025-04322-0

ORIGINAL ARTICLE

Analysis of efficacy of picosecond laser treatment for nevus of Ota

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Received: 3 July 2024 / Accepted: 23 January 2025

Abstract

To analyze the efficacy, safety, and influencing factors of 1064 nm picosecond Nd: YAG laser(PSAL)treatment for Nevus of Ota. From January 2018 to March 2024, 212 patients with Nevus of Ota were treated with 1064 nm picosecond Nd: YAG laser at the Guangzhou Dermatology Hospital. The study analyzed the impact of patient gender, age, Tanino classification of skin lesions, color of skin lesions, Fitzpatrick classification of skin, and number of treatments on efficacy, while also documenting any adverse reactions to the treatment. Overall, out of the 212 patients who underwent 1 to 11 treatment sessions, 80 cases (37.73%) achieved complete clearance, 42 cases (19.81%) showed excellent outcomes, 45 cases (21.22%) had good outcomes, 37 cases (17.45%) saw fair outcomes, and 8 cases (3.77%) had minimal effect, resulting in an overall effective rate of 78.77%. The study revealed a correlation between treatment efficacy, age, and the number of laser treatments ($P<0.05$). Multifactorial logistic regression analysis demonstrated a positive association with treatment effectiveness (odds ratio 3.324; 95% confidence interval 2.110–5.238). Other variables such as gender, Tanino classification of skin lesions, color of skin lesions, and Fitzpatrick skin type showed no significant correlation with efficacy ($P>0.05$). Among the patients, two experienced temporary post-inflammatory effects, while three exhibited folliculitis. Notably, there were no reported cases of persistent erythema, scarring, or hypopigmentation. The treatment of Nevus of Ota using 1064 nm picosecond Nd: YAG laser has been demonstrated to be both safe and effective, with treatment efficacy impacted by patient age and the number of treatment sessions. Early intervention and higher frequency of treatment sessions are associated with improved treatment outcomes.

Keywords Nevus of Ota · Picosecond Nd: YAG laser · Therapeutic efficacy

Introduction

The Nevus of Ota, also known as oculodermal melanocytosis, typically manifests as a unilateral blue or brownish-black macule on the face, following the pattern of the ophthalmic or maxillary branches of the trigeminal nerve. While it mostly presents at birth, it can also emerge later in life [1]. The condition predominantly affects females, with 80% of cases occurring in this demographic, and unilateral involvement is observed in 95% of cases. Lasers have been found to be the most effective treatment modality for this condition. Picosecond lasers have the capability to produce and administer a pulse of high energy in under a nanosecond. These lasers gained approval for tattoo removal in 2012, and researchers have since been exploring their extensive applications beyond tattoos, such as pigment clearance and tissue remodeling. The rapid delivery of a high-energy pulse within a short timeframe generates photoacoustic effects without causing harsh, adverse, or thermal effects [2]. A study by Ge and colleagues [3] reported that picosecond alexandrite laser(PSAL) arm achieved a significantly better clearance with fewer sessions and less severe pain. Patients were more satisfied with PSAL than Q-switched alexandrite laser (QSAL)for nevus of Ota.

Shaoyin Ma and Hai Zhu are both the co-first author of this study.

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Published online: 06 February 2025

However, prior reports have been constrained by a limited number of cases, lacking a comprehensive large-sample retrospective analysis. The aim of this retrospective study was to assess the effectiveness, safety, and factors influencing the use of 1064 nm picosecond Nd: YAG laser in treating nevus of Ota.

Methods

Subjects

The study incorporated 212 patients diagnosed with Nevus of Ota who underwent picosecond Nd: YAG laser therapy at Guangzhou Dermatology Hospital between January 2018 and March 2024, serving as the sample population for clinical data analysis. Exclusion criteria included pregnancy or lactation, prior laser, chemical peel, or depigmenting agent treatments within the last year, or photosensitivity and cases with incomplete data. All patients or their guardians provided informed consent.

Pre-treatment preparation

Patient details should be meticulously documented, and either a Canfield VISIA 1-CR system (Canfield Scientific, Inc., NJ, US) or a handheld digital camera (Canon EOS 750D, CanonCorp, Tokyo, Japan) should be utilized to capture frontal and lateral 45° photos of the patient's face. An hour before the treatment, a compound lidocaine cream (10 g per tube, containing 25 mg of prilocaine and 25 mg of lidocaine per gram, Ziguang Pharmaceutical Co., Ltd. Beijing, China) should be applied, and covered with a dressing for 1 h.

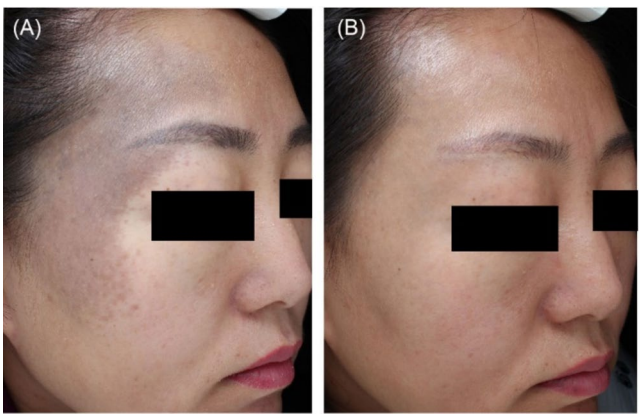

Fig. 1 Clinical image (**A**) before treatment, (**B**) after 4 treatments using 1064 nm picosecond Nd: YAG laser

Laser treatment

The picosecond Nd: YAG laser (PicoWay; Candela, Wayland, MA) was employed for treatment, utilizing a single-pass, full-beam mode with a wavelength of 1064 nm, spot sizes of 3–4 mm, energy densities ranging from 2.8 to 4.0 J/cm², and a frequency of 3 Hz. Laser parameters were adjusted based on the lesion's location, color, age, tanning classification and immediate skin response. The treatment endpoint was defined as mild purpura. A 30-minute immediate cold compress post-treatment is recommended, and patients are advised on sun protection post-treatment. The treatment sessions are spaced 3 to 6 months apart, and follow-up is conducted via phone, online, or at revisit visits to record any adverse reactions such as hyperpigmentation, folliculitis, scarring, and persistent erythema, as well as the duration of these adverse reactions.

Treatment evaluation

Treatment evaluation before and 3–6 month after the each treatment, photographs are taken, and two physicians assess the degree of lesion regression based on the pre- and post-treatment photos using a five-point grading scale: complete clearance (95–100%), excellent (75–94%), good (50–74%), fair (25–49%), minimal (0–24%).

Statistical analysis

The data was analyzed using SPSS 29 Statistics. Analysis includes using analysis of variance (ANOVA) to assess whether factors such as gender, age, Tanino classification of lesions, color, Fitzpatrick classification of skin, and number of treatments affect treatment efficacy in patients with Nevus of Ota. Additionally, unconditional logistic regression is employed to analyze the correlation between gender, age, Tanino lesion classification [1], color, Fitzpatrick skin type, number of treatments, and treatment efficacy. The relative risk (odds ratio, OR), 95% confidence interval (95% CI), and chi-square value (X^2) are calculated, with statistical significance set at $P < 0.05$.

Results

Among 212 patients with Ota's nevus, there were 68 males and 144 females, with ages ranging from 3 months to 56 years, averaging 18.59 ± 11.69 years. The complete clearance rate was observed in 34 cases (16.04%) (Figs. 1, 2 and 3). Additionally, there were 79 cases with an excellent response (37.26%), 52 cases with a good response (24.53%), 38 cases with a fair response (17.92%), and 9

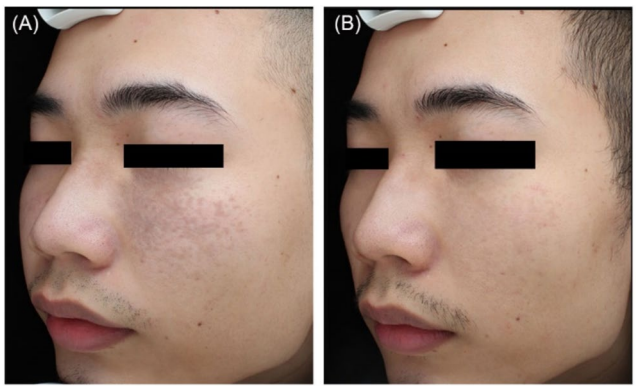

Fig. 2 Clinical image (**A**) before treatment, (**B**) after 3 treatments using 1064 nm picosecond Nd: YAG laser

cases deemed ineffective (4.25%). Overall, this resulted in an effective rate of 77.83%. Table 1 showed the correlation between sex, age, Tanino classification, lesion color, lesion types, treatment sessions and outcomes. By incorporating all significant factors from univariate logistic regression analysis along with clinically significant variables using a forward stepwise approach, a multivariate logistic regression model was constructed. The results indicated a significant association between age groups, treatment frequency, and treatment efficacy based on univariate analysis, with statistically significant differences observed between groups ($P<0.05$) (Table 2). By introducing two statistically significant variables from the univariate analysis into the logistic multivariate regression equation, the unconditional logistic regression analysis revealed that younger age and increased treatment frequency were associated with better treatment outcomes (Table 3), demonstrating statistically significant differences ($P<0.05$). while treatment frequency showed a positive correlation with treatment effectiveness (odds ratio3.324, 95% confidence interval 2.110–5.238). Of the patients, two experienced pigment deposition which resolved spontaneously within 3 to 6 months, and three cases developed folliculitis, showing improvement after a 7-day course of topical antibiotic cream, without enduring adverse reactions such as persistent erythema, scarring, or pigment fading.

Discussion

The Nevus of Ota, a type of dermal melanocytosis, was initially documented in 1939 as pigmented nevi affecting both the skin and the eye. It typically appears during childhood or adolescence as unilateral mottled brown or blue-gray pigmented macules in regions innervated by the ophthalmic and maxillary branches of the trigeminal nerve [4]. The pigmentation gradually intensifies in size and hue until puberty. In around 60% of cases, the nevi are present at birth and evolve within the initial decade of life. Hence, timely intervention for Nevus of Ota may yield favorable outcomes [5].

A study by Seo et al. [5]reported that Childhood nevus of Ota is likely to be more superficial than the adult nevus, therefore early laser treatment of nevus of Ota might have some beneficial effects in children. Patients who started their first treatment earlier required fewer treatment sessions to reach moderate, marked, and near total improvement. Early intervention in treating lesions is beneficial in mitigating the impact of environmental factors (e.g., ultraviolet radiation) and personal factors (e.g., acne) [5]. Within this study, it was observed that the therapeutic outcomes for patients aged$\leq$20 years were notably superior to those aged$>$20 years, although no statistically significant variance in efficacy was observed across age groups.

The colors of nevus of Ota are classified as blue-black, brown, and light-brown, with corresponding efficacy rates of 74.26%, 80.95%, and 88.24%, respectively. This indicates that darker lesion colors are associated with lower efficacy rates, potentially necessitating a higher number of treatment sessions. Despite the differences in the number of treatment sessions needed for each color of pigmented lesion, the final treatment effect did not show a significant difference among the three colors.

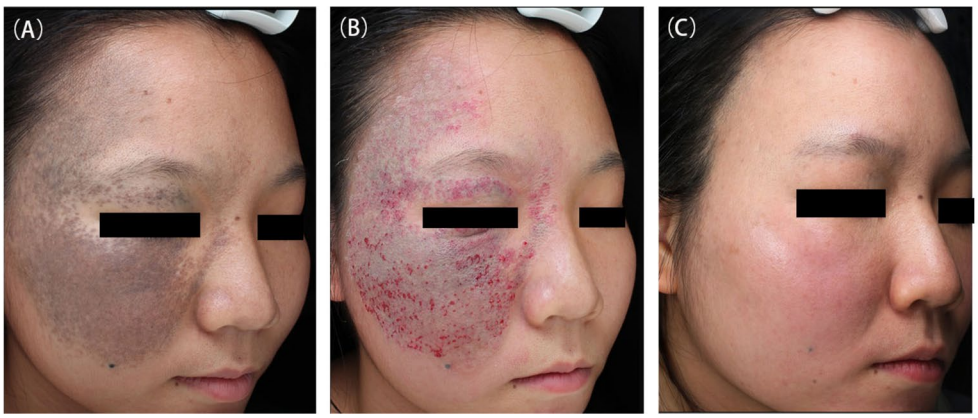

Fig. 3 Clinical image (**A**) before treatment, (**B**) immediate response after treatment, (**C**) after 5 treatments using 1064 nm picosecond Nd: YAG laser

Table 1 The correlation between sex, age, tanino classification, lesion color, lesion types, treatment sessions, and effect

Variables	Improvement						Therapeutic effect (%)
	Total ($n=212$)	95–100% ($n=34$)	75–94% ($n=79$)	50–74% ($n=52$)	25–49% ($n=38$)	0–24% ($n=9$)	
Gender, n							
Man	68	8	28	17	12	3	77.94
Woman	144	26	51	35	26	6	77.78
Age, n(%)							
≤10	57	7	24	18	8	1	85.96
11–20	48	10	22	9	6	1	85.42
21–30	82	15	21	21	19	5	69.51
≥31	25	2	12	4	5	2	72
Tanino classification							
I	100	15	32	29	19	5	76
II	103	19	42	20	19	3	78.64
III	3	0	2	1	0	0	100
IV	6	0	3	2	0	1	83.33
Leison color							
Blue-black	136	22	51	28	29	6	74.26
Brown	42	7	15	12	6	2	80.95
Light brown	34	5	13	12	3	1	88.24
Fitzpatrick, n							
III	186	32	68	46	32	8	78.49
IV	26	2	11	6	6	1	73.08
Number of sessions							
1	66	0	8	23	26	9	46.97
2	52	1	23	20	8	0	84.62
3	30	8	14	6	2	0	93.33
4	28	9	16	2	1	0	96.43
5	24	11	11	1	1	0	95.83
≥6	12	5	7	0	0	0	100

The Tanino classifications, categorized based on the extent of cutaneous involvement, were as follows [1]:

IA: Involving upper or lower eyelids, periorbital area, and temporal region

IB: Affecting the area below the eyelids, nasolabial fold, and zygomatic region

IC: Present on the forehead

ID: Located on the nasal region

II: Extending over the upper and lower eyelids, periocular area, zygomatic region, cheek, and temple

III: Spread across the scalp, forehead, eyebrow, and nose

IV: Manifesting bilaterally

Table 2 The relationship between each factor and treatment efficacy was analyzed through single-factor regression analysis

		Score	df	Sig.
Variables	Gender	0.001	1	0.979
	Age	4.176	1	0.041
	Tanino classification	0.621	1	0.431
	Leison color	3.371	1	0.066
	Fitzpatrick	0.388	1	0.533
	Number of sessions	38.583	1	<0.001
Overall Statistics		46.293	6	<0.001

In the cases reported in our study, we observed that one patient showed improvement of over 95% after two sessions, and eight patients experienced similar improvement after three sessions of picosecond laser treatment for Nevus of Ota. Among these, after three treatment sessions, 66.7% of patients showed improvement of ≥75%. Picosecond laser treatment demonstrated excellent efficacy, rapid onset of action, fewer treatment sessions required, and a significant increase in efficacy rates with an increasing number of treatments [6]. Yang et al. demonstrated that, following a single

Table 3 Multivariate analyses of treatment effect relevant factors

	β	S.E	Wald	P	OR	95%CI
Age	-0.345	0.196	3.088	0.079	0.079	0.482–1.041
Number of sessions	1.201	0.232	26.822	<0.001	3.324	2.110–5.238

treatment with a 1064 nm picosecond Nd: YAG laser, the mean efficacy score for 16 patients was 2.56. Additionally, the mean efficacy scores for 13 patients who received two treatments and for nine patients who underwent three treatments were 3.15 and 3.51, respectively [7]. These findings suggest that in comparison to a 1064 nm PSNL, QSNL may require a greater number of treatment sessions to achieve a comparable effect [3]. We also found that treatment outcomes were suboptimal for the upper eyelid area, particularly in children. The main reasons are the difficulty in cooperation and the sensitivity of this region, which necessitated lower energy settings.

Three patients developed folliculitis, with the probable cause attributed to their existing acne condition. It is hypothesized that the inability to cleanse their faces properly post-treatment led to an increase in sebum secretion, thus contributing to the occurrence of folliculitis. Further research is needed to investigate whether the development of folliculitis is related to skin microvascular rupture and subsequent production of inflammatory cytokines following picosecond laser treatment.

Several limitations were present. The uncontrolled retrospective design and the fact that the study was conducted at a single center do limit the generalizability of the findings. Additionally, retrospective analyses have inherent biases and limitations that can impact the validity of the results. Clinical photographic assessment is inherently subjective and therefore prone to bias. Because the study was retrospective, there was no standard follow-up, and therefore rates of recurrence could not be assessed, though any recurrence present in the post-treatment photograph was reflected in the physician's assessment. The rate of complications could also not be accurately assessed due to above limitations.

Conclusions

Picosecond Nd: YAG laser therapy for Nevus of Ota could be considered as an effective and safe method. Enhancing therapeutic efficacy can be achieved by optimizing the treatment regimen through increasing the number of sessions and initiating treatment early.

Funding Guangzhou Basic Research Plan Jointly the City, School (Hospital), and/or Enterprise (Grant No. 2024A03J0560).

Declarations

Ethical approval Ethics approval was not required for this research.

Informed consent All patients or their guardians were fully informed about the study, and written informed consent. Informed Consent: was obtained before treatment.

Conflict of interest None.

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