

Evaluation of the efficacy and safety of a 1064nm picosecond Nd:YAG laser for the treatment of atrophic acne scars in Asians

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Summary

Objective: To evaluate the efficacy and safety of a 1064nm picosecond Nd:YAG laser for atrophic acne scars in Asians. **Subject and method:** Twenty-three patients with atrophic acne scar lesions were included in this study. Patients were treated with a 1064nm picosecond Nd:YAG laser every 4 weeks for three sessions. The treatment results were evaluated after 1 month of the third session. **Result:** All patients had a definite reduction in acne scar amount after each session that was maintained during follow-up. Rolling scars and ice-pick responded better (26.7%; 30.8%) to laser treatment than boxcar (15.9%). The Goodman and Baron scores fell from 18.3 ± 7.4 to 13.5 ± 6.8 (a 26.2% improvement), and the change was significant $p = 0.001$. **Conclusion:** The 1064nm picosecond Nd:YAG laser is safe and effective for the treatment of acne scars in Asians.

Keywords: Atrophic acne scar, 1064nm Nd:YAG picosecond laser, fractional picosecond laser.

1. Background

Acne is the most common chronic inflammatory disease of hair follicles and sebaceous glands in adolescents and adults. Atrophic scars are a common sequela of acne. About 95% of acne patients would have acne scars of varying degrees [1]. Facial atrophic scars can cause damage to the patient's appearance, often adversely affect the patient's social activities and mental health, and seriously affect the patient's quality of life. Currently, acne scarring's main treatment methods include grinding, surgical release, RF, chemical peeling, microneedling, microdermabrasion, platelet-rich plasma, and laser therapy... [8]. Laser therapy is currently the most widely used clinical treatment for

acne scarring. However, both traditional laser and lattice laser are from the photothermal effect principle, often difficult to control accurately, leading to damage to the surrounding normal tissues, and outcomes reported are often biased. Traditional lasers, including CO2 fractional lasers, have a beneficial effect on acne atrophic scars, but they can cause scabbing, lengthy work delay, obvious pain, and a higher risk of pigmentation after treatment. Therefore, finding a therapeutic method with sufficient efficacy and safety is the main challenge facing the clinic. To overcome those limitations, in recent years picosecond lasers have been applied. In the treatment of acne scars with the principle of laser-induced optical breakdown (LIOB) and picosecond laser-induced cavitation (LIC) affecting the scar tissue regeneration process and collagen proliferation is stimulated at the greatest rate with little damage to surrounding tissues, while the epidermis remains intact, reduces pain and burning, does not require recovery time, and reduces hyperpigmentation [5]. Some studies evaluating the

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effectiveness of picosecond laser in treating acne scars in the world, but domestic studies are still limited. Therefore, we conducted research with the aim: "Evaluation of 1064nm picosecond Nd:YAG laser efficacy in atrophic acne scars treatment".

2. Subject and method

2.1. Subject

Twenty-three subjects aged 15-42 years with Fitzpatrick skin type III-IV were treated at 108 Military Central Hospital from 1/2021 to 10/2022.

Inclusion criteria

Subjects were required to have bilateral, mild to severe facial acne scars; sufficient photographs before each treatment; adequate treatment (at least 3 treatments) and re-examination on time.

Exclusion criteria:

Subjects who are pregnant or are breastfeeding, have a sensitivity to light, have an active tan, have a significant skin condition on the face, a history of squamous cell carcinoma or melanoma, a history of keloid scarring or abnormal wound healing, or who are prone to bruising, or have used isotretinoin within 12 months of the initial treatment were excluded from the study.

Study design

Research intervention studies, cross-sectional descriptions, vertical monitoring, and self-comparison.

Laser treatment

A topical anesthetic cream containing 2.5% lidocaine and 2.5% prilocaine (EMLA 5%; AstraZeneca

LP, Wilmington, DE) was applied 15-30 minutes before treatment and consequently wiped off with sterile gauze. A frequency-doubled Nd:YAG picosecond-domain laser system (PicoWay, Syneron-Candela Corporation, Wayland, MA), fitted with a holographic beam-splitting optic (PicoWay Resolve, Syneron-Candela Corporation) was used for laser treatments. The system delivers a 10 x 10 array of 150mm-diameter microbeams arranged in a 6mm x 6mm, square treatment area. The laser delivered from 1.3-2.9 mJ/microbeam at 1,064nm with a pulse-duration of 450 ps. Treatments were administered using a repetition rate of 10Hz. Three to four passes were made over the entire acne scars area of the face with a 15-20% overlap. All subjects received three treatments at one-month intervals. Immediately after the procedure, transient erythema and swelling were noted in the treatment area. The endpoint of treatment was moderate erythema with mild-to-moderate swelling of the treated facial skin and mild-to-moderate purpura. Subjects were instructed to avoid excessive sun exposure, and to wear a broad-spectrum sunscreen with a sun protection factor of 50 all throughout the study period after crusting had completely healed.

Evaluation

Photos were taken of patients before each treatment session and then again at 1 month after the third treatment session. Two experienced dermatologists evaluated the results via the Qualitative and Quantitative Global Scarring Grading System based on the photography.

Goodman and Baron's quantitative global acne scarring grading system 2016 (GSS) [4]

(Grade)Type	No. of lesion		
	1-10	11-20	> 20
(A) Milder scarring (1 point each): - Macular erythematous or pigmented - Mildly atrophic dish-like	1pts	2pts	3pts
(B) Moderate scarring (2 points each): - Moderately atrophic dish-like - Punched out with shallow bases small scars (< 5mm) - Shallow but broad atrophic areas	2pts	4pts	6pts

(Grade)Type	No. of lesion		
	1-10	11-20	> 20
(C) Severe scarring (3 points each): - Punched out with deep but normal bases, small scars (< 5mm) - Punched out with deep abnormal bases, small scars (< 5mm) - Linear or troughed dermal scarring - Deep, broad atrophic areas	3pts	6pts	9pts

The quartile grading scales reflected an improvement in the scar appearance

< 25% difference = slightly better; 25-50% = fair; 51-75% = good; > 75% = excellent.

Subjects assessed their satisfaction with the treatment outcome at the 12-week follow-up visit using a 5-point Likert scale (-2 = Very dissatisfied, -1 = Dissatisfied; 0 = No opinion, 1 = Satisfied, 2 = Very satisfied).

Safety assessments

Immediate adverse effects (AEs), including erythema, edema, purpura, and pain, were recorded after each treatment. The visual scoring method assessed the pain (0-10 points, 0 points = no pain, 10 points = maximal pain). The mean scores of the three assessments were calculated. Long-term AEs, including hyperpigmentation, hypopigmentation, and pruritus, were evaluated one month after the last treatment.

2.2. Analysis method

Statistical analysis was made using SPSS® 22.0 software package. Descriptive statistics were presented as mean $\pm$ standard deviation. The statistical significance value was accepted as $p < 0.05$.

3. Result

Characteristics of participants

Table 1. Patient characteristics (n = 23)

Sex	Female	16/23 (69.56%)
	Male	7/23 (30.44%)
Age (years)	Mean	28.9 $\pm$ 7.8
	Min - Max	15-42
Duration of acne scars (years)	Mean	8.4 $\pm$ 4.7 years
	Min - Max	2 - years

The average age of the study group was 28.9 $\pm$ 7.8 years. The average scarring time was 8.4 $\pm$ 5.5 years. There were more women than men.

Table 2. Mean Goodman and Baron score after treatments (n = 23)

	Before treatment	After 8 treatments	p
Mean $\pm$ SD	18.3 $\pm$ 7.4	13.5 $\pm$ 6.8	0.001
Point decreased (%)	4.8 $\pm$ 5.3 (26.2%)		

According to the scoring scale by Goodman and Baron, the average number of point scars reduced by 4.8 $\pm$ 5.3 points after 3 treatments (similar corresponding 26.2%). There was a statistically significant with $p = 0.001$ (< 0.05).

Table 3. The effectiveness of treatment was evaluated based on the morphology of scars (n = 23)

Morphology of Scars	Number of scars before treatments (Mean $\pm$ SD)	Number of scars after three treatments (Mean $\pm$ SD)	Rate of reduction in number of scars (%)	Level of improvement (%)	p
Boxcar	13.8 $\pm$ 3.9	11.6 $\pm$ 3.2	15.9	Slightly better	<0.001
Rolling	27.7 $\pm$ 9.6	20.3 $\pm$ 4.5	26.7	Fair	
Ice-pick	23.4 $\pm$ 15.2	16.2 $\pm$ 8.6	30.8	Fair	
Total	64.9 $\pm$ 36.2	48.1 $\pm$ 32.8	25.9	Fair	

Ice-pick scars and rolling scars both improved with an average reduction of 30.8% and 26.7%, respectively; Boxcar improved the least, reduced by 15.9% at a small level of improvement. The difference was statistically significant with $p < 0.001$.

Table 4. Adverse effects (n = 23)

Adverse effects			n
Immediate AEs	Pain (Mean $\pm$ SD)	4.13 $\pm$ 1.75	
Long-term AEs	New Scars		0
	Hyperpigmentation		0
	Hypopigmentation		0

Most patients in the study group showed no side effects after treatment.

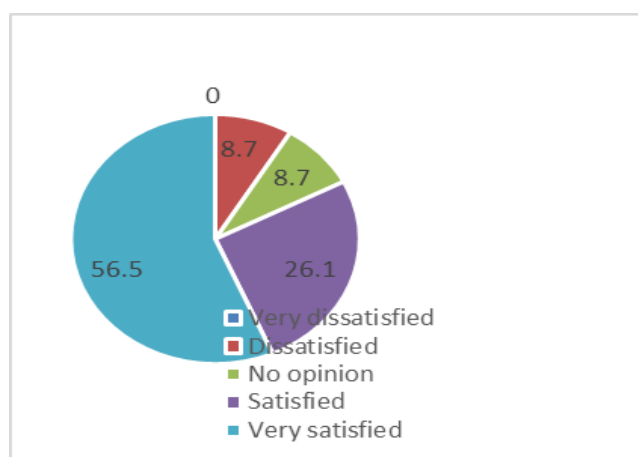


Figure 1. Level of patient satisfaction with treatment results

Most patients were satisfied and very satisfied with the treatment results.

4. Discussion

Patient clinical research group

In our study group, there were 23 patients with post-acne scars with an average age of 28.9 ± 7.8 years old, the youngest being 15 years old, the oldest being 42 years old. The age group of 28.9 ± 7.8 is also a group of people who work, have social communication activities, pay more attention to aesthetic factors and also have better economic conditions, so the rate of going for examination and treatment is higher than other age groups. Our results are similar to the research of foreign authors such as Manuskiatti et al (2020) [6] which is 31.96 ± 6.03 years old, the youngest

is 21 years old, the oldest is 39 years old. The duration of scarring ranged from 2 to 18 years with an average of 8.4 ± 4.7 years (Table 1).

The incidence rate of women (69.56%) is higher than that of men (30.44%). Quite consistent with the study of Bernstein et al (2017) [2] on 27 patients, the incidence of acne scars in women is higher than in men (85.2% compared to 14.8%). Our results are different from the study by Dai et al (2019) [3] conducted on 20 patients, which showed a higher rate of patients with acne scars in men (65%) than women (35%).

This difference may be due to different characteristics of the study population and the sample size is not large enough. The proportion of women is higher than that of men in our study patient group, possibly because women are more interested in aesthetics than men, leading to a higher rate of examination and treatment.

Assessment of treatment in acne scar by picosecond laser

Atrophic scars are a common sequela after acne caused by the destruction of collagen after acne inflammation. Commonly found in the facial area, it greatly affects the patient's aesthetics and quality of life. Therefore, the need for treatment of atrophied acne scars is increasing. In recent years, picosecond lasers have been applied in skin rejuvenation and acne scar treatment with the principle of selectivity, photoacoustic effect, laser-induced optical breakdown (LIOB) and laser-induced cavitation (LIC). Picosecond laser with extremely short pulse duration and extremely high peak power leads to a rapid temperature increase causing extremely rapid expansion in the target tissue. The heat generated will gather in the target tissue without spreading. High pressure exceeding the fracture threshold of the target tissue causes explosive vaporization of the target tissue. Fragments are destroyed by phagocytosis, which will initiate the wound-healing

process and stimulate the synthesis of new collagen and elastin. Furthermore, when using the Fractional handpiece to treat post-acne scars, the power density is increased, creating strong shock waves into the dermis and dermis, the plasma reaction occurs before the photons reach the dermis, creating vacuoles under the skin, initiating the regeneration and repair process to fill scar tissue [5].

According to the results of Table 2, the average Goodman and Baron scar score after three treatments decreased from 18.3 ± 7.4 to 13.5 ± 6.8 , decreasing 4.8 ± 5.3 points (corresponding to 26.2%) the difference is statistically significant with $p = 0.001$ (<0.05). Research by Yang et al (2020) [8] on 18 acne scar patients completed the study, after 6 treatments, the average Goodman and Baron scar score decreased from 15.22 to 10.72. (down 29.6%). The improvement of the patients in our study was less than the author's, perhaps due to the more severe scarring through a larger average pre-treatment Goodman and Baron score and the number of our treatments being three treatments while Yang had six treatments.

Research results show that picosecond Nd:YAG laser affects all types of scars. The average number of scars of all scar types decreased with $p < 0.001$, which is statistically significant (Table 3). Rolling scars and ice-pick scars improved an average of 30.8%; 26.7%; boxcar improved the least, reduced by 15.9%. Our

results are similar to Shi et al (2021) [7] study on 22 patients, showing better improvement in ice-pick and rolling scars compared to the boxcar.

In the study by Manuskiatti et al (2020) [6] on 26 patients treated 6 times (every 4 weeks) with 1064nm picosecond laser, the average pain score on a 10-point scale was shown to be 4.34 ± 1.44 ; Reactions immediately after treatment are erythema, mild to moderate swelling, some have petechiae that last for 5-7 days, the rate of hyperpigmentation is 18% (28 out of 156 treatment sessions). In our study, patients mainly had mild to moderate pain. Immediate reactions after treatment were erythema, edema, and mild petechiae. There were no cases of hyperpigmentation. This can be explained by differences in the number of laser pulses emitted, the area of treatment area, and post-treatment care.

Dai et al (2019) [3] studied 20 patients with post-acne scars. After 3 treatments (every 4 weeks), the average scar improvement score was 3/10 (10-point scale), the level of satisfaction according to the Likert scale showed that 55% of patients were satisfied and 25% of patients were very satisfied with the treatment results. In our study, after completing the 3-treatment course, 56.5% of patients were satisfied and 26.1% were very satisfied with the treatment results, especially with almost no downtime (Figure 1).



Fig. 1. A 29-year-old female patient presented with a few red, atrophic acne scars on her face. After three sessions with better improvement.



Fig. 2. A 25-year-old male patient presented with severe atrophic acne scar on his face. After three sessions with better improvement.

5. Conclusion

The 1064nm picosecond Nd:YAG laser is safe and effective for the treatment of acne scars in Asians. Rolling scars and ice-pick responded better (26.7%; 30.8%) to laser treatment than boxcar (15.9%).

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