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Long-Pulsed Nd:YAG Laser as a Therapeutic Option for Striae Distensae

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Abstract
Introduction: Striae distensae (SD), widely recognized as stretch marks, present as linear dermal atrophic scars in numerous individuals and are often challenging to treat. The 1064-nm long-pulsed (LP) Nd: YAG laser has been shown to stimulate collagen synthesis in the skin, alongside its established efficacy in managing vascular lesions, thereby contributing to the improvement of immature SD.
Objective: To assess the efficacy and safety of the Nd:YAG laser in the management of SD.
Patients and methods: This single blinded, comparative, and prospective study included 15 female patients with SD. The body area of each patient was divided into right (treated by Nd:YAG laser) & left (not treated "control") sides.
Results: Nd:YAG (right side) showed improvement after treatment regarding clinical assessment by improvement grade and patient satisfaction. No reported adverse effects after Nd: YAG laser.
Conclusion: Nd:YAG lasers are effective in treatment of striae rubra especially on flanks.

Keywords: Striae distensea, Laser, Nd:YAG

Introduction
Striae distensae (SD), widely recognized as stretch marks, are visible linear dermal scars resulting from excessive skin stretching and subsequent dermal injury. These lesions may present with erythematous, violaceous, or hypopigmented coloration [1]. They are quite prevalent and can result in severe discomfort and cosmetic morbidity for people who are impacted. However, if they are significant, trauma or extreme stretching may cause them to rupture or ulcerate [2].
The prevalence rates and anatomical locations are affected differently by age and sex. This disorder affects among adolescents, 70% of females and 40% of males [3].
Although their causes may vary, they frequently arise during pregnancy, puberty, and obesity [4]. They also appear in a wide range of other illnesses, including Cushing's syndrome, Marfan syndrome, connective tissue diseases, diabetes, hypercortisolism, and chronic exposure to the usage of systemic or topical steroids [5]. Although the afflicted anatomical regions vary greatly, the abdominal region, breast, thighs, and buttocks are the most often affected areas [2].
Rarely do they raise serious health issues. But they put a strain on the patients' mental health. Striae provide an important challenge for medical professionals in terms of assessment and care [1]. 810-nm diode lasers, 308-nm excimer lasers, 1064-nm neodymium-doped yttrium aluminium garnet (Nd: YAG) lasers, 585-nm pulsed dye lasers, and ablative fractional CO2 resurfacing lasers are among the lasers used to cure stretch marks [6].
Nd:YAG is a crystalline material commonly utilized as the lasing medium in solid-state lasers. Because of their high oxyhaemoglobin content, the dilated venules and perivascular infiltration of lymphocytes observed in SD lesions are targets for the Nd:YAG laser. This leads to the delivery of targeted energy into the dermal tissue, thereby increasing collagen synthesis within the skin [7].

Patients and Methods
This single blinded, comparative, prospective study enrolled 15 female patients presenting

with striae distensae, selected from the Outpatient Clinic of the Dermatology and Venereology Department at Tanta University Hospitals between August 2023 and January 2024. Ethical approval was obtained from the Research Ethics Committee of the Faculty of Medicine, Tanta University Hospitals (approval code: 36264MS243/7/23).
Female patients between 18 to 45 years old presented with SD with skin photo type III and IV, who had not undergone any treatment for striae for at least six months prior to enrollment and who provided informed consent were included in the study. While those with current infection in the treated area or with any other skin or chronic disease or history of keloid formation, bleeding and coagulation disorders, pregnancy or those demonstrating unrealistic expectations were omitted from enrollment. All subjects underwent thorough history taking, general and dermatological examination, local examination of striae (site, number, diameter, color, skin atrophy and shine).

The Nd-YAG laser: The Quanta System's Duetto evo laser system high power, Italy 2020, Nd-YAG laser that emits 1064nm laser light. The power and pulse duration were adjusted based on the skin response to it seeking for color change or erythema appearing immediately after the pulse.

- **Fluence:** 120-170 J/cm^2.
- **Spot size:** 5 mm.
- **Frequency:** 1Hz.
- **Pulse duration:** 15-25 msec.

Assessment of the efficacy of the therapeutic procedure:

- Digital photographs were captured at baseline, prior to each monthly treatment session, and again three months following the final session for follow-up evaluation. A photographic evaluation was done with the same equipment, lighting, and location.
- **Improvement grade [8]:** a 5 points scale as following: no improvement or worsening of SD, Mild improvement (if improvement < 25%), Moderate improvement (if improvement 25-49%), Marked improvement (improvement 50-74% and Excellent improvement (improvement ≥75%).
- **Patient satisfaction [9, 10]:** Not satisfied (Worse or No change), Slightly satisfied (Improved), Satisfied (Much improved), Very satisfied (Very much improved).

Statistical analysis of the data

Data were entered into a computer and analyzed using IBM SPSS Statistics software version 20.0 (Armonk, NY: IBM Corp., 2011). Qualitative variables were presented as frequencies and percentages.
The Shapiro-Wilk test assessed the normality of data distribution. Quantitative variables were summarized using range (minimum-maximum), mean ± standard deviation, median, and interquartile range (IQR). Statistical significance was set at a p-value less than 0.05.

The tests used were:

1. **Wilcoxon signed ranks test**
   For non-normally distributed quantitative variables, to compare between two periods.
2. **Marginal Homogeneity Test**
   Used to analyze the significance among the different stages.

Results

This study included 15 female patients presenting with striae rubrae. The lesions on the right side of each patient's body were treated with the Nd:YAG laser, while the corresponding lesions on the left side served as untreated controls. The period of striae in the studied patients from 1.0 - 8.0 months with a mean of 5.43 ± 1.76. They were developed due to increased body weight in 70.0% of patients,
post-pregnancy in 23.3% and due to steroid use in 6.7%. 26.7% had striae on the hips, 26.7% on abdomen, 20% on popliteal fossae, 13.3% on arms and 13.3% on inner thigh. Table (1)

Table 1: Distribution of the Studied Cases According to Clinical Criteria of Striae (n = 15)

Site	No.	%
Flanks	4	26.7
Abdomen	4	26.7
Popliteal	3	20
Arms	2	13.3
Inner thigh	2	13.3
Number		
>10	10	66.7
5 to 10	4	26.7
1 to 4	1	6.7
Diameter (cm)		
Min. - Max.	0.30 - 0.60	
Mean ± SD.	0.49 ± 0.09	
Median (IQR)	0.50 (0.40 - 0.60)	
Color		
Dark red	10	66.7
Pink	3	20
Purple	2	13.3

On the right side treated with Nd:YAG laser, 8 patients (53.3%) exhibited excellent improvement, 2 patients (13.3%) showed marked improvement, 1 patient (6.7%) demonstrated moderate improvement, 3 patients (20%) had mild improvement, and 1 patient (6.7%) showed no improvement (Table 2). Regarding patient satisfaction, 40% reported being very satisfied, 20% satisfied, 26.7% slightly satisfied, and 13.3% not satisfied with the treatment outcomes on the treated side. Table (3)

Table 2: Improvement Grades of Striae Following Treatment with Long-Pulsed Nd:YAG Laser

Improvement grade	Patients (n = 15)	
	No.	%
No improvement or worse (0)	1	6.7
Mild improvement (1% - 25%)	3	20.0
Moderate improvement (26% - 50%)	1	6.7
Marked improvement (51% - 75%)	2	13.3
Excellent improvement (76% - 100%)	8	53.3

Table 3: Patient Satisfaction Following Treatment with Long-Pulsed Nd:YAG Laser.

Patient satisfaction	Patients (n = 15)	
	No.	%
Not satisfied	2	13.3
Slightly satisfied	4	26.7
Satisfied	3	20.0
Very satisfied	6	40

Discussion

Striae, a connective tissue condition caused by cutaneous atrophy, affects a sizable fraction of people worldwide. Even though it is typically not a medical issue that impairs quality of life, it creates psychological suffering. They progress through two stages in clinical practice: striae rubrae, which is characterized by erythematous, raised, and inflammatory symptoms, and striae albae, which is characterized by whiteness, depression, and small wrinkles [11]. SD are believed to be linked to a substantial alteration in the structure of connective tissue, including collagen, elastin, and fibrillin fibers, as well as a reduction in the capacity of fibroblasts to produce new tissue [12].

There is not a single gold standard treatment now. The three main objectives of SD treatment are to improve pigmentation, decrease erythema, or collagen formation [13]. Immature striae rubra can be efficiently addressed with the 1064-nm Nd: YAG laser, which is widely known to address vascular lesions and has also demonstrated the ability to promote the production of dermal collagen [14, 15]. The absorption of the long-pulsed Nd:YAG laser by the dermal vasculature raises the surrounding temperature, promoting collagen remodeling and wound healing [16].

fifteen females with SD aged between 18 to 45 years old presented with SD with skin photo type III and IV were treated by Nd:YAG laser on the right side of the body, and the left side of the body was control. All patients had three treatment sessions at four-week intervals, with a follow-up assessment conducted three-month follow-up post-final session.

Numerous studies were conducted to assess the effectiveness of Nd:YAG laser, either by itself or in conjunction with other therapeutic methods, in treating striae distensae [7, 17-19]. 26.7% of the females had SD on their hips, 26.7% on their abdomen, 20% on their popliteal fossae, 13.3% had on arms and 13.3% on inner thigh. It was discovered that all patients with striae on the popliteal fossae had increased body weight, whereas 62.5% of patients with striae on the belly had pregnancy-related striae.

These results were in in accordance with those of El Nagdy *et al*. (2023) [12], and Mammadov *et al*. (2024) [21], who said that the most prevalent location for striae gravidarum is the abdomen [10-21]. Additionally, Masood *et al*., 2020 showed that large dosages of oral steroids can result in deep, broad striae [22].

In terms of improvement grade [8], following treatment with Nd:YAG laser, A statistically confirmed enhancement was observed on the right side, as evidenced by the presence of 53.3% of patients with improvement > 75%. These outcomes are in line with those of a study conducted in by Hendawy *et al*., 2021 [17] which examined the effects of Nd:YAG and fractional CO2 lasers on 70 females with Fitzpatrick skin types III-V. The study documented that the Nd:YAG laser was more efficacious because the thickness of collagen and epidermal tissue increased more in the lesions treated by the Nd: YAG laser than in the lesions managed by the fractional CO2 laser. Nd: YAG laser therapy also produced significantly higher improvement score values than fractional CO2 laser therapy, with 7 (23.3%) and 12 (40%) lesions showing very much improvement and much improvement, respectively, compared to 16 (53.3%) and 8 (26.7%) lesions that exhibited either progress or stability following fractional CO2 laser treatment (P<0.001) [17].

In research by Elsaie *et al*., 2016 [7] that compared Nd:YAG laser fluences (75 and 100 J/cm2), 45 patients had four treatment sessions administered at three-week intervals and were monitored for three months following the wrap up of the treatment period. In both wavelengths, the length and breadth of the stria demonstrated a significant improvement post-treatment relative to baseline, with the difference reaching high statistical significance (p=0.00) [7].

Regarding patient satisfaction, a statistically meaningful improvement was observed on the right side, with 60% of patients expressing between very satisfied and satisfied on the right side (long-pulsed Nd:YAG laser). These findings were also similar with a research by Hendawy *et al*., 2021 [17], which found that 70 female patients were significantly more satisfied with Nd:YAG laser therapy than fractional Co2 laser therapy three months after treatment [17].

Regarding adverse effects, no reported adverse effects after Nd:YAG laser treatment. These findings aligned with research conducted by Gungor *et al*., 2014 [18] and Hendawy *et al*., 2021 [17], which found no adverse effects linked with long-pulsed Nd:YAG [17, 18].

Fig 1: A 27-year-old female patient, Fitzpatrick's type III, with striae rubrae on flanks, since 7 months due to increased body weight. (a) Right side before treatment. (b) Right side three months after the last treatment session showing excellent improvement.

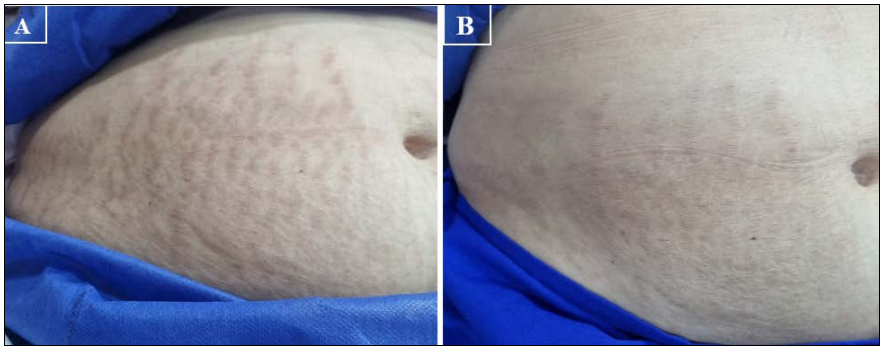

Fig 2: A 27-year-old female patient, Fitzpatrick's type III, with striae rubrae on abdomen, since 6 months due to pregnancy.(a) Right side before treatment. (b) Right side three months after the last treatment session showing marked improvement.

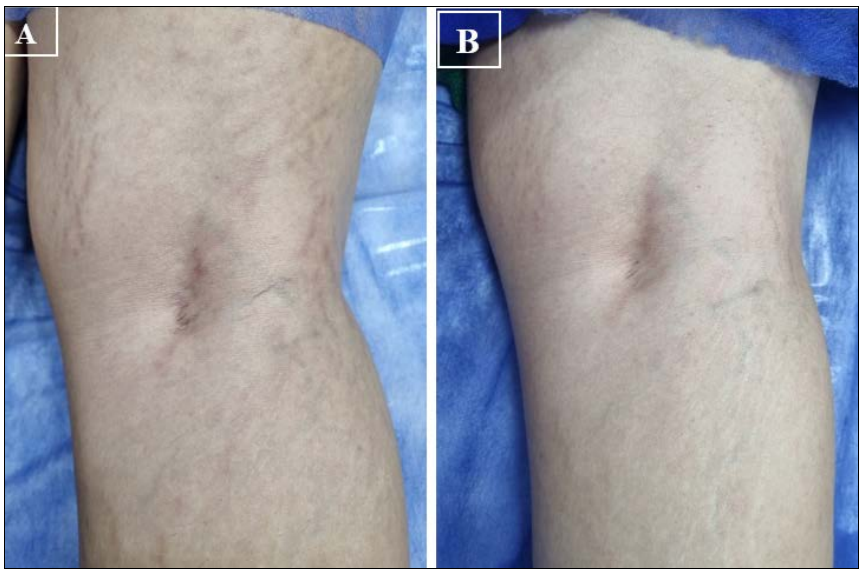

Fig 3: A 24-year-old female patient, Fitzpatrick's type IV, with striae rubrae on both popliteal fossae, in the last 4 months due to increased body weight. (a) Right side before treatment (b) Right side three months after the last treatment session showing moderate improvement.

Conclusions

Long pulsed Nd:YAG laser demonstrated efficacy and safety in the management of striae rubrae but more effective in flanks treatment than abdomen.

The more time left for the striae in the follow up, the better the results were found.

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Nil

Conflict of Interest

Nil

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