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The Effectiveness and Safety of 1470 nm Non-Ablative Laser Therapy for the Treatment of Striae Distensae: A Pilot Study

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Abstract

Striae distensae (SD), or stretch marks, are a common aesthetic concern with limited effective treatment options. This prospective, single-center, open-label study aimed to evaluate the efficacy and safety of 1470 nm non-ablative laser therapy in improving skin texture and reducing SD dimensions. Twenty healthy female volunteers (aged 19–56) with SD of varying stages underwent three laser sessions at three-week intervals. Treatments were delivered using energy densities of 28–35 mJ per point with spot spacing of 0.8–1.2 mm, uniformly delivered over the affected SD lesions. Assessments were performed at baseline, Day 14, Day 35, Day 56–70, and Day 118–132. SD depth and width were measured using high-frequency ultrasound; aesthetic improvement was assessed using the Global Aesthetic Improvement Scale (GAIS), alongside clinical and photographic evaluations. A statistically significant, progressive reduction in SD size was observed: mean depth decreased from 0.34 mm (SD = 0.16) to 0.18 mm (SD = 0.15), and width decreased from 6.58 mm (SD = 2.65) to 4.40 mm (SD = 2.52) by Day 118–132 ($p < 0.01$ for both). Most participants reported improvement on GAIS at each follow-up. No severe adverse events occurred; only mild, transient erythema and edema were noted. In conclusion, 1470 nm non-ablative laser therapy showed significant efficacy and a favorable safety profile in SD treatment, offering a promising non-invasive option based on fractional thermal stimulation and selective dermal absorption.

Keywords: non-ablative fractional laser; 1470 nm; striae distensae; laser treatment

Academic Editor: Mark Birch-Machin

Received: 10 May 2025
Revised: 7 July 2025
Accepted: 9 July 2025
Published: 11 July 2025

Citation: Kubik, P.; Bighetti, S.; Bettolini, L.; Gruszczyński, W.; Łukasik, B.; Guida, S.; Stabile, G.; Paolino, G.; Murillo Herrera, E.M.; Carugno, A.; et al. The Effectiveness and Safety of 1470 nm Non-Ablative Laser Therapy for the Treatment of Striae Distensae: A Pilot Study. *Cosmetics* **2025**, *12*, 148. https://doi.org/10.3390/cosmetics12040148

1. Introduction

Striae distensae (SD), commonly referred to as stretch marks, are a prevalent dermatological condition that can cause considerable cosmetic concern among individuals [1]. These atrophic dermal lesions, marked by a noticeable thinning of the epidermis, can affect individuals of all ethnic backgrounds and are often seen in various regions of the body such as the buttocks, thighs, knees, breasts, calves, and the lumbosacral area [2–4]. While the precise etiology of SD remains elusive, several factors have been suggested to play a role. Hormonal changes, along with the mechanical stretching and rupture of connective tissue, can contribute to their formation [2,3]. Experiences such as the physiological changes of pregnancy, the rapid growth spurts commonly seen during adolescence, fluctuations in weight, and elevated levels of serum steroids all seem to connect to the development of these lesions [3,5].

SD typically present as flat or slightly elevated pink-to-red lesions, referred to as striae rubrae. These early-stage lesions may often be accompanied by sensations of itching or discomfort due to the skin's stretching. Histopathological examination of these immature SD reveals underlying inflammation, characterized by elastolysis in the mid-dermis and degranulation of mast cells [3,6]. As these lesions mature and undergo atrophic changes, they evolve into a white or silver coloration, identified as striae albae. During this phase, histological analysis shows signs of epidermal atrophy, a flattening of the rete ridges, and the presence of densely packed, horizontally aligned eosinophilic collagen bundles, which resemble scar tissue [6,7].

Additional forms of SD include striae gravidarum, associated with pregnancy, and striae atrophicans, which may develop as a result of prolonged corticosteroid use or conditions that increase skin tension such as weightlifting and rapid muscle hypertrophy.

While SD do not present a medical threat, they can significantly affect the psychological well-being of those affected, potentially diminishing self-esteem and quality of life. Although SD may gradually fade over time, they seldom resolve completely without specific intervention. Numerous treatment modalities have been investigated for the management of SD, including topical tretinoin, hydrating creams, chemical peels, microdermabrasion, and skin needling; however, the outcomes of these treatments have been largely inconsistent and often unsatisfactory [8–19].

Other non-laser interventions, such as hyaluronic acid-based formulations and microneedling, have demonstrated variable efficacy [17–19]. While microneedling promotes dermal remodeling via controlled injury, it often requires multiple sessions and may carry a risk of post-inflammatory hyperpigmentation in darker skin types [18,19]. Topical tretinoin, though beneficial in early-stage SD, is frequently limited by irritation and poor compliance [8,9,12]. Radiofrequency-based technologies offer thermal stimulation but are highly operator-dependent and lack standardized protocols [17]. Despite their variety, no current therapy has demonstrated universal effectiveness, underscoring the need for more predictable and long-lasting solutions [17].

As a result, SD remain a therapeutic challenge for clinicians, due to the limited effectiveness and predictability of currently available treatments. Laser-based modalities, particularly fractional ablative and non-ablative technologies, have gained increasing attention for their ability to improve cutaneous texture and atrophic lesions through the induction of controlled dermal remodeling. These systems function by creating microscopic columns of thermal injury at specific dermal depths, stimulating neocollagenesis, elastin production, and epidermal regeneration, ultimately enhancing skin elasticity and surface appearance [20,21].

Despite encouraging outcomes with traditional wavelengths such as 1540 nm and 1550 nm, there is limited evidence supporting the clinical utility of newer wavelengths with

higher selectivity for dermal water content [2,3]. Among these, the 1470 nm wavelength is characterized by a higher water absorption coefficient, enabling selective dermal targeting with minimal epidermal disruption [20,21]. However, its role in the management of SD remains underexplored.

The present study was therefore designed to evaluate the safety and efficacy of a novel 1470 nm non-ablative fractional laser system for the treatment of SD. We hypothesized that this device would achieve measurable aesthetic improvements by reducing lesion depth and width, while enhancing dermal volume and structural integrity. By combining objective ultrasound-based measurements with subjective assessments, this investigation seeks to expand the existing body of evidence on fractional laser therapy and clarify the clinical potential of the 1470 nm wavelength in SD management.

2. Materials and Methods

2.1. Selection of Study Population

A cohort of twenty healthy female volunteers, aged between 19 and 56 years (mean age 33.9 ± 9.22), experiencing SD (ICD-10 code: L90.6), was selected for this study (Table 1). Each qualified participant underwent a series of three treatments utilizing a 1470 nm laser, with sessions scheduled two to three weeks apart. The study implemented strict exclusion criteria to ensure participant safety and the integrity of the results. Individuals were excluded if they had used oral and/or topical retinoids within six months prior to the study, exhibited excessive tanning, were diagnosed with active skin or connective tissue diseases with photosensitivity (e.g., systemic lupus erythematosus, collagenopathy, or cutaneous porphyria), experienced active herpes simplex infections, or had utilized medications or photoreactive cosmetics (such as tetracycline antibiotics, immunosuppressive drugs like cortisone and its derivatives, anticoagulants including dipyridamole and coumarin derivatives, or cosmetics containing thyme extract or herbs like St. John's wort) in the six months prior. Additional exclusion criteria included diseases resulting in immunodeficiency (as determined by qualifying physicians), uncontrolled diabetes, recent cosmetic or aesthetic procedures in the treatment area (with decisions made by the qualifying physician based on specific procedures performed), acquired vitiligo or disorders affecting melanin production (e.g., hypermelanosis), the presence of tattoos in the treatment area, and the use of anti-inflammatory drugs. This investigation was designed as a pilot study to preliminarily assess the efficacy and safety profile of the 1470 nm non-ablative laser in SD treatment. Accordingly, no formal sample size calculation was performed; the number of enrolled participants (n = 20) was based on feasibility and consistency with similar exploratory studies in the field. All participants provided informed consent prior to their involvement in the study. This research adhered to the guidelines outlined in the Declaration of Helsinki and received approval from the Ethics Committee of the Medical Chamber in Gdańsk, Poland (Reference: KB-(9)17/2023).

Table 1. Patient age, gender, and anatomical location of treated SD.

Patient ID	Gender	Age	SD Location
1	F	19	breast
2	F	50	abdomen
3	F	25	abdomen
4	F	18	back

Table 1. *Cont.*

Patient ID	Gender	Age	SD Location
5	F	56	abdomen
6	F	35	abdomen
7	F	34	abdomen
8	F	35	buttocks
9	F	32	thighs
10	F	35	hips
11	F	35	thighs
12	F	39	thighs
13	F	24	thighs
14	F	36	abdomen
15	F	35	abdomen
16	F	33	buttocks
17	F	36	abdomen
18	F	39	buttocks
19	F	23	breast
20	F	39	abdomen

2.2. Assesment and Treatment Protocol

Participants in the study received LaserMe (Matex Lab S.p.A., Geneva, Switzerland) treatments characterized by an energy density of 28–35 mJ per point, with a spacing of 0.8–1.2 mm, and applied uniformly to areas affected by SD. These laser parameters align with the standard clinical application of the device. Each patient underwent a total of three sessions of 1470 nm laser therapy, scheduled three weeks apart. The outcomes of the treatment were assessed using a range of evaluation methods, including photographic documentation of the treatment process and high-frequency ultrasound analysis of skin structure. Potential adverse effects were diligently monitored throughout the duration of the study. Data on key metrics, including SD depth and width, were collected at the following timepoints: Before Treatments, Day 14 (14 days after the first session), Day 35 (21 days after the second session), Day 56–70 (28–35 days after the third session), and Day 118–132 (90 days after the end of treatments). Additionally, the GAIS was used to assess patients perceived improvement in relation to their initial condition (baseline) at each of the four follow-up visits (Day 14, Day 35, Days 56–70, and Days 118–132). Participants were asked to subjectively rate the effectiveness of the treatment compared to their baseline appearance, by selecting one of the following scores: 1 = “very much improved”, 2 = “much improved”, 3 = “improved”, 4 = “no change”, and 5 = “worse”.

2.3. High-Frequency Ultrasound Evaluation

In order to evaluate the size of SD before and after treatment, high-frequency ultrasound was employed. The depth and width of representative SD were carefully assessed, ensuring that at least one representative lesion was examined for each patient. The findings are reported in millimeters, with a precision of 0.01 mm. For the purpose of consistent measurements, high-frequency ultrasound (Draminski, 48 MHz, Draminski Technology, Olsztyn, Poland) was utilized to conduct repeated assessments of two SD lesions in each patient.

2.4. Statistical Analysis

The dataset was organized using Microsoft Excel™ version 2305 and subsequently imported into IBM SPSS® version 29.0.1.0 and STATA® for statistical analysis. Continuous data were expressed as means with standard deviations (SD), while categorical data were summarized as frequencies and percentages. Normality of the distributions was assessed using the Kolmogorov–Smirnov test, and homogeneity of variances was verified with Levene's test. Differences in SD depth and SD width across the timepoints (Before Treatment, Day 14, Day 35, Day 56–70, and Day 118–132) were assessed using repeated-measures ANOVA. The assumption of sphericity was tested using Mauchly's test. When the assumption of sphericity was violated, the Greenhouse–Geisser correction was applied. Changes in GAIS scores across follow-up visits were assessed using the Friedman test. All statistical analyses were two-tailed, with a significance level (α) set at 0.05.

3. Results

3.1. SD Depth

The assessment of SD depth showed an initial mean depth of 0.34 mm (SD = 0.16) before treatment. Observations at Day 14 (14 days after the first treatment session) indicated a reduction to 0.31 mm (SD = 0.15), corresponding to a decrease of 8.82% from baseline. Further evaluations at Day 35 (21 days after the second session) revealed a continued decline to 0.27 mm (SD = 0.13), equating to a reduction of 20.59%. By Day 56–70 (28–35 days after the third session), the mean depth further decreased to 0.23 mm (SD = 0.13), marking a 32.35% reduction. Finally, at Day 118–132 (90 days after the end of treatments), the average depth reached 0.18 mm (SD = 0.15), indicating a 47.06% reduction from the initial measurement. These findings underscore a statistically significant decline in SD depth over time, thereby highlighting the effectiveness of the laser treatment ($p < 0.01$) (Figures 1 and 2).

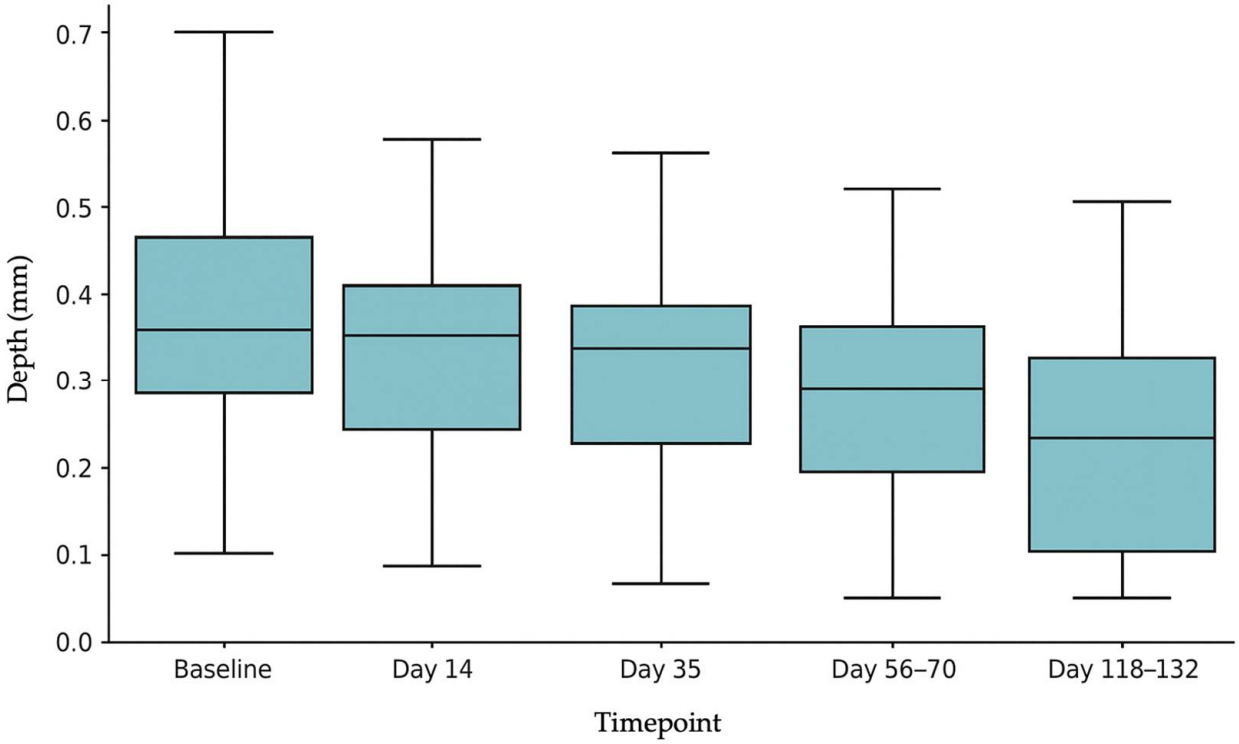

Figure 1. Mean SD depth at each follow-up timepoint during 1470 nm laser treatment. Statistical analysis was performed using repeated-measures ANOVA (two-tailed, $p < 0.05$).

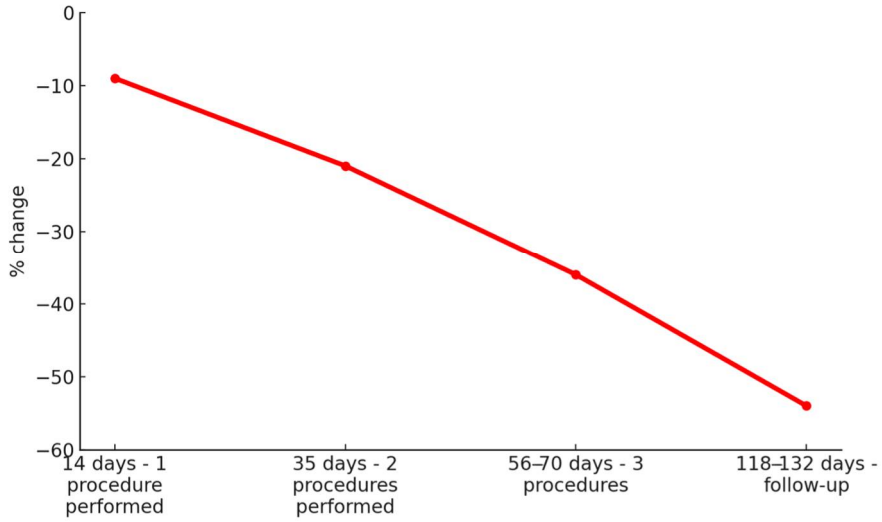

Figure 2. Percentage change in SD depth at each follow-up timepoint compared to baseline.

3.2. SD Width

The analysis of SD width demonstrated that the mean width prior to treatment was 6.58 mm (SD = 2.65). After the first treatment session, the mean width was 5.88 mm (SD = 2.47) at the 14-day mark, reflecting a decrease of 10.64% from baseline. At 35 days post-treatment, the width further reduced to 5.20 mm (SD = 2.33), corresponding to a reduction of 20.97%. By day 56–70, the mean width was measured at 4.76 mm (SD = 2.63), signifying a 27.66% reduction. Finally, at 118–132 days, the mean width reached 4.40 mm (SD = 2.52), marking a 33.13% decrease from baseline. These findings demonstrate a progressive reduction in SD width over time, providing robust evidence for the effectiveness of 1470 nm laser therapy ($p < 0.01$) (Figures 3 and 4).

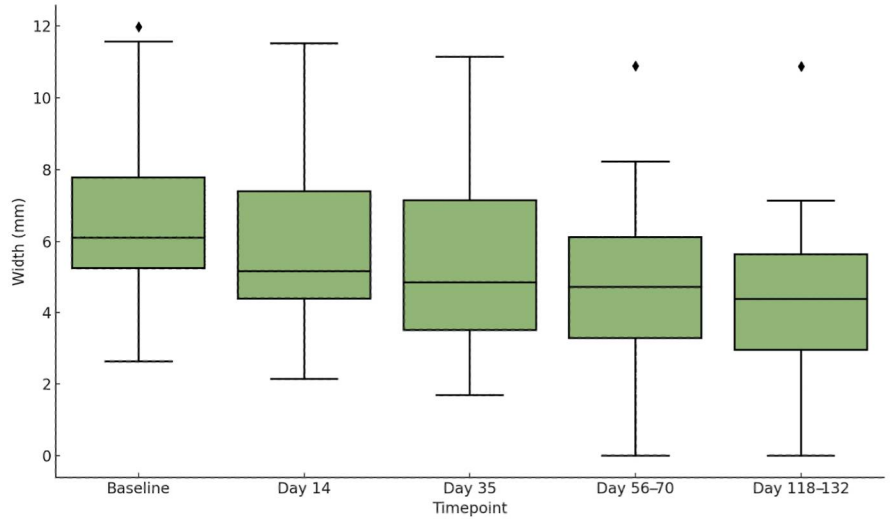

Figure 3. Mean SD width at each follow-up timepoint during 1470 nm laser treatment. Differences over time were assessed using repeated-measures ANOVA (two-tailed, $p < 0.05$). Statistical outliers, shown as diamond-shaped markers, are defined as values beyond 1.5 times the interquartile range.

These results display a statistically significant reduction in both SD depth and SD width, as detailed in Table 2. Figure 5 presents the methodology and the treatment effects regarding SD width and depth reduction before and after the procedure evaluated with high-frequency ultrasound.

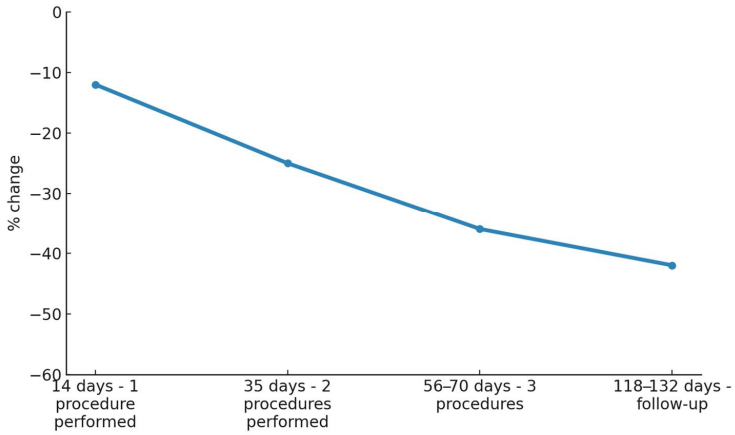

Figure 4. Percentage change in SD width at each follow-up timepoint compared to baseline.

Table 2. Summary of the treatment results. Longitudinal changes in SD width and depth at baseline and follow-up visits.

Timepoint	Mean Width (mm)	Standard Deviation (Width)	Change vs. Baseline (Width)	*p*-Value Width	Mean Depth (mm)	Standard Deviation (Depth)	Change vs. Baseline (Depth)	*p*-Value Depth
Before Treatments	6.58	2.65	-	-	0.34	0.16	-	-
Day 14 (14 days after 1st treatment)	5.88	2.47	−10.64%	<0.001	0.31	0.15	−8.82%	<0.01
Day 35 (21 days after 2nd treatment)	5.20	2.33	−20.97%	<0.001	0.27	0.13	−20.59%	<0.001
Day 56–70 (28–35 days after 3rd treatment)	4.76	2.63	−27.66%	<0.001	0.23	0.13	−32.35%	<0.001
Day 118–132 (90 days after end of treatments)	4.40	2.52	−33.13%	<0.001	0.18	0.15	−47.06%	<0.001

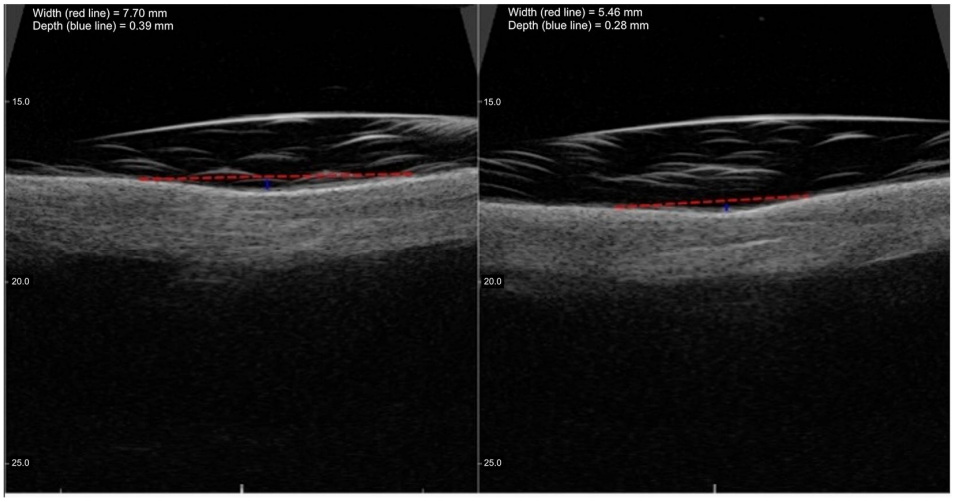

Figure 5. Representative high-frequency ultrasound images showing the reduction in SD width and depth before and after 1470 nm non-ablative laser therapy. The left panel shows baseline evaluation, while the right panel corresponds to Day 118–132 post-treatment. A marked decrease in lesion depth and dermal indentation is visible, consistent with progressive tissue remodeling and clinical improvement. The blue line and the red line indicate the width and the depth of the SD lesion, respectively.

3.3. GAIS Score and Adverse Events

At Day 14, 85% of patients rated their appearance as “improved”, “much improved”, or “very much improved”, with 5% reporting the highest score. At Day 35, the proportion

of improved cases rose to 95%, with 50% rating "much improved" or better. At Days 56–70 and 118–132, 95% of participants maintained a subjective improvement, while 5% reported "no change". None of the patients reported worsening at any timepoint. Statistical analysis using the Friedman test revealed a significant variation in GAIS scores across the follow-up period ($p < 0.01$), indicating a dynamic but overall favorable patient-perceived aesthetic response over time (Figure 6). Representative pre- and post-treatment images are presented in Figure 7, illustrating visible improvements in skin texture and lesion morphology consistent with both ultrasound metrics and patient-reported outcomes.

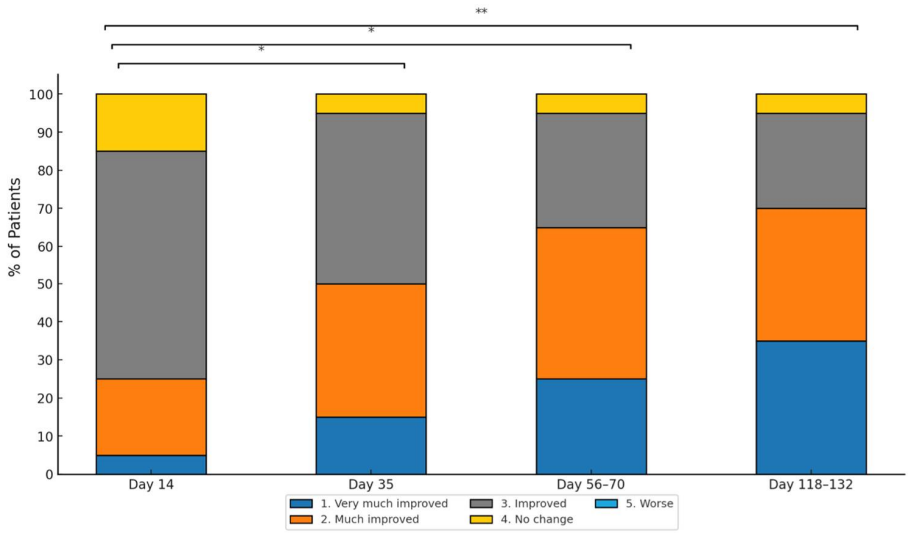

Figure 6. Percentage distribution of GAIS scores at each follow-up visit (Day 14, Day 35, Days 56–70, and Days 118–132), based on patient self-assessment relative to baseline. * indicates a statistically significant difference compared to Day 14 ($p < 0.05$); ** indicates a highly significant difference compared to Day 14 ($p < 0.01$).

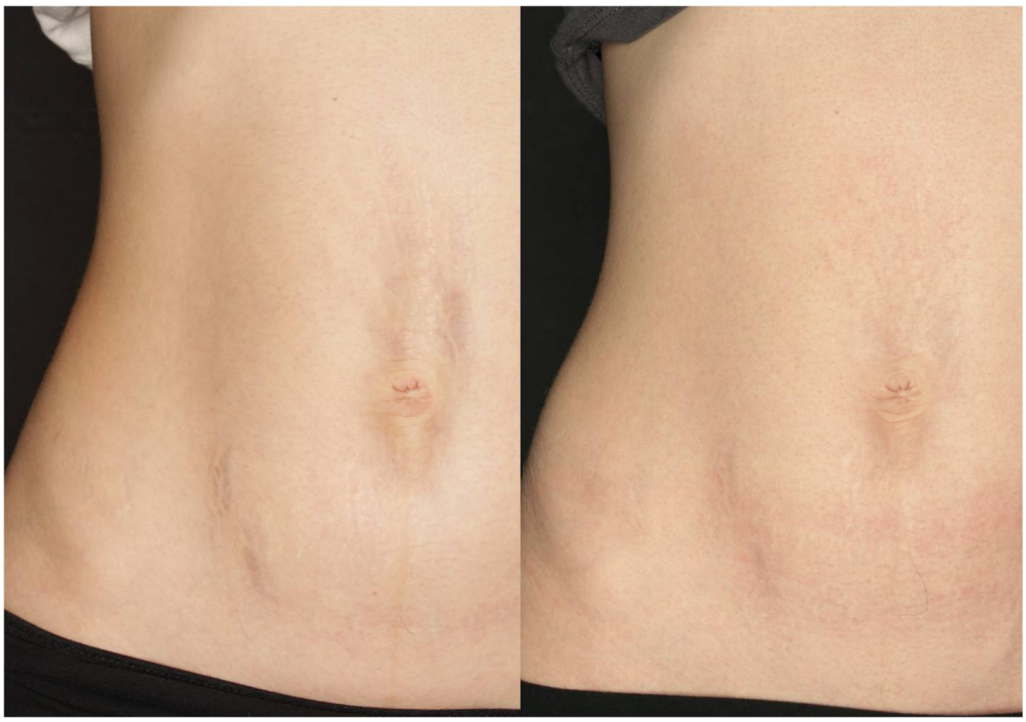

Figure 7. Clinical acquisitions of a representative patient before and after 1470 nm non-ablative fractional laser treatment, showing noticeable improvement in striae distensae appearance (baseline vs. Day 118).

3.4. Safety and Tolerability

Mild erythema and edema were observed in all patients after each procedure, typically resolving within 24–48 h without requiring any medical intervention. Notably, no cases of crusting or post-inflammatory hyperpigmentation were reported throughout the study.

4. Discussion

This prospective pilot study demonstrated that three sessions of 1470 nm non-ablative fractional laser therapy produced a progressive and statistically significant reduction in SD dimensions. By the final follow-up (Day 118–132), the mean SD depth had decreased by 47.06% and width by 33.13%. These objective improvements were accompanied by high patient satisfaction, with up to 95% of participants reporting visible aesthetic benefits on the GAIS. Furthermore, the treatment was well tolerated, with only mild, transient side effects such as erythema and edema reported, typically resolving within 24–48 h, and no adverse events affected patient quality of life. These outcomes suggest that this laser modality may represent a promising non-invasive option for SD management.

Effectively addressing SD presents a significant challenge [22,23]. As with many chronic dermatological conditions, SD can profoundly influence patients' quality of life, often impacting their emotional well-being and self-esteem [24,25]. In the management of patients with SD, the primary objectives are to alleviate erythema, swelling, and irritation associated with early-stage striae rubrae, while aiming to enhance collagen and elastin fiber production, improve skin hydration, and reduce inflammation in striae albae [26]. In light of these therapeutic goals, the observed clinical patterns in our study offer valuable insight into the distinct biological responses elicited by fractional laser treatment.

It is important to highlight that the changes in SD width exhibited a more dynamic pattern during the early stages of treatment, with a deceleration in the rate of improvement noted during subsequent follow-ups. In contrast, the changes in SD depth demonstrated a distinct trend: although initial improvements were modest, the final outcomes indicated a more significant enhancement compared to width reduction. A plausible explanation for this phenomenon lies in the thermal mechanism induced by the laser, which may lead to a rapid contraction of pre-existing cutaneous protein structures, particularly altered collagen and reticular fibers, resulting in an early reduction in lesion width. In contrast, the dermal remodeling process mediated by neocollagenesis requires a longer biological timeframe, progressively contributing to the reduction in striae distensae depth observed during the later phases of treatment.

Recent analyses conducted on healthy volunteers have substantiated that treatment utilizing the 1470 nm laser facilitates a consistent and predictable healing process while preserving skin integrity [20,21]. The underlying mechanism of this laser involves the creation of micro-zones of fractional heating within the dermis, which stimulates new collagen production and enhances skin structure. This thermal effect evokes a controlled regenerative response, resulting in increased collagen density and a mild inflammatory process, both of which contribute to the progressive remodeling of SD. Notably, the surrounding healthy tissue remains intact, reinforcing the favorable safety profile of this treatment. These findings are consistent with the principles of fractional laser therapy, which aims to selectively and effectively stimulate the skin's natural repair mechanisms [20,21,26,27].

Subjective assessments using the GAIS reflected a consistently high level of patient satisfaction throughout the study, aligning with the objective improvements measured by ultrasound. Interestingly, the peak subjective improvement appeared to precede the maximal objective reduction in SD depth, which became more pronounced at later timepoints. This temporal divergence suggests that patients may base their early satisfaction on surface-level or visual changes (such as reduction in width or erythema), while deeper structural

remodeling, though objectively measurable, may be less perceptible to the patient. These findings underscore the importance of integrating both objective and subjective outcome measures in SD management, as they provide complementary insights into treatment efficacy and patient satisfaction.

Several treatment modalities have been investigated for the management of striae distensae, including topical agents (such as tretinoin), microneedling, and various energy-based devices. Topical tretinoin has demonstrated modest efficacy, particularly in early-stage striae rubrae, but its use is often limited by irritation and patient compliance issues [8,9]. Microneedling, which induces collagen remodeling through controlled dermal injury, has shown favorable outcomes in some studies, though typically requires multiple sessions and presents a risk of post-inflammatory hyperpigmentation in darker skin types [18,19]. Ablative lasers such as fractional CO_2 and non-ablative devices like 1540 nm Er:Glass have also been explored with promising results, yet are often associated with more downtime or a higher risk of adverse effects [4,28].

Compared to these options, the 1470 nm laser evaluated in our study produced comparable or greater improvements in both SD depth and width, while maintaining excellent tolerability and high patient satisfaction. The absence of serious adverse events and the predictability of recovery support its potential for integration into routine clinical dermatology. Its wavelength-specific affinity for water-rich dermal tissue likely contributes to its efficacy while minimizing epidermal damage. Although no significant adverse effects were observed in this study, clinicians should carefully assess individual risk factors before applying laser therapy, particularly in patients with pigmentary disorders such as vitiligo, where thermal stimulation may pose additional risks [29].

While the findings of the current study are promising, it is important to acknowledge certain limitations that should be considered when interpreting the results. The primary limitation is the absence of a control group, as well as a lack of comparison with other established treatment methods for SD, such as fractional ablative lasers or microneedling. Future studies should include larger sample sizes, a randomized controlled design, direct comparisons with other laser techniques, and subjective as well as objective outcome measures.

5. Conclusions

SD represent a common cosmetic concern that can significantly affect an individual's confidence and overall sense of well-being. Effectively addressing SD requires a comprehensive approach that extends beyond standard skin care, necessitating targeted therapies designed to improve both the appearance and texture of the affected skin. Based on the outcomes observed in this study, the 1470 nm non-ablative fractional laser appears to be a safe and promising modality for non-invasive SD management. Randomized controlled trials with comparative arms and longer follow-up are needed to further validate its efficacy and to define its position relative to other established treatments for SD.

Author Contributions: P.K.: conceptualization, methodology, writing—original draft preparation, supervision; S.B.: data curation, formal analysis, writing—original draft preparation; L.B.: validation, writing—review and editing; W.G.: methodology, investigation; B.Ł.: software, visualization, data curation; S.G.: writing—review and editing, investigation; G.S.: validation, resources; G.P.: resources, writing—review and editing; E.M.M.H.: Formal Analysis, writing—review and editing; A.C.: data curation, investigation; M.V.: supervision, methodology; C.Z.: validation, writing—review and editing; V.M.: supervision, writing—review and editing; E.D.: software, visualization; N.Z.: project administration, writing—review and editing. All authors have read and agreed to the published version of the manuscript.

Funding: This research received no external funding.

Institutional Review Board Statement: The study was conducted in accordance with the Declaration of Helsinki and approved by Ethics Committee of the Medical Chamber of Gdańsk, Poland (protocol code KB-(9)17/2023, 24/01/2023).

Informed Consent Statement: Written informed consent was obtained from all subjects involved in the study. Written informed consent has been obtained from the patients to publish this paper.

Data Availability Statement: The data that support the findings of this study are available from the corresponding author upon reasonable request.

Conflicts of Interest: The authors declare no conflicts of interest.

Abbreviations

The following abbreviations are used in this manuscript:

SD	Striae Distensae
ICD	International Classification of Diseases
HFUS	High-Frequency Ultrasound
SPSS	Statistical Package for the Social Sciences
ANOVA	Analysis of Variance
PRP	Platelet-Rich Plasma
SVF	Stromal Vascular Fraction
CO2	Carbon Dioxide
Er:Glass	Erbium:Glass
Er:YAG	Erbium-doped Yttrium Aluminium Garnet
IPL	Intense Pulsed Light
PDL	Pulsed Dye Laser
GAIS	Global Aesthetic Improvement Scale
SD width	Width of Striae Distensae
SD depth	Depth of Striae Distensae

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