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ORIGINAL RESEARCH

Effectiveness and Safety of the Use of 1470 nm Laser Therapy in Patients Suffering From Acne Scarring of the Facial Skin

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Purpose: This prospective, single-center, open-label study aimed to evaluate the efficacy and safety of 1470 nm non-ablative laser therapy in treating facial acne scars. The primary objective was to assess improvements in skin texture, elasticity, and scar depth and diameter, while confirming the absence of significant adverse effects.

Patients and Methods: 40 healthy female volunteers aged 18 to 42 years with facial acne scars underwent three sessions of 1470 nm laser therapy at two-week intervals. Outcome measures included cutometric assessments, high-frequency ultrasound evaluations, and clinical photographic documentation, conducted at baseline and on days 21, 42, 70, and 130 post-treatment.

Results: Significant improvements were observed across all evaluated parameters. Skin elasticity increased progressively from baseline (mean: 62.95, SD=4.0) to day 21 (63.72, SD=3.8, +4%), day 42 (67.11, SD=4.0, +6%), day 70 (69.08, SD=4.2, +11%), and day 130 (70.80, SD=4.4, +14%; $p<0.001$). High-frequency ultrasound measurements revealed substantial reductions in scar depth, which decreased by 5% at day 21 (mean: 0.18 mm, SD=0.05, $p<0.001$), 20% at day 42 (0.15 mm, SD=0.055, $p<0.001$), 48% at day 70 (0.10 mm, SD=0.06, $p<0.001$), and 63% at day 130 (0.07 mm, SD=0.065, $p<0.001$). Scar diameter followed a similar trend, with reductions of 16% at day 21 (3.08 mm, SD=0.3, $p<0.001$), 26% at day 42 (2.71 mm, SD=0.34, $p<0.001$), 42% at day 70 (2.13 mm, SD=0.36, $p<0.001$), and 62% at day 130 (1.39 mm, SD=0.38, $p<0.001$). Clinical photographic evaluations corroborated these quantitative findings, showing visible improvements in scar appearance and overall skin texture. No adverse events were reported throughout the study.

Conclusion: The 1470 nm non-ablative laser therapy demonstrated high efficacy and safety in the treatment of acne scars, delivering substantial therapeutic benefits and high patient satisfaction, offering a valuable therapeutic option for addressing both pigmentation and textural issues associated with acne scars.

Keywords: acne scars, non-ablative laser, 1470 nm laser therapy, skin elasticity, scar reduction

Introduction

Acne vulgaris is prevalent among individuals aged 11 to 30, affecting about 80% of this demographic, with nearly 100% of adolescents displaying minimal acne lesions. This condition is equally distributed between genders, with the peak incidence occurring in girls between ages 14–17 and in boys between ages 16–19. Acne onset in prepubescent individuals is increasingly observed, and the persistence of acne into adulthood is unpredictable While most teenagers see resolution of lesions within 3–5 years, some may experience persistent acne for more than a decade.[1–3]

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The development of acne is linked to changes during adolescence, affecting seborrheic areas. Acne lesion formation involves increased sebum production, excessive follicular keratinization, proliferation of P. acnes bacteria, and the development of an inflammatory response.[3] The resultant hyperpigmentation and scars, both atrophic and hypertrophic, can lead to scarring, with atrophic scars appearing most commonly on the face and central back. Hypertrophic scars, including keloids, are observed on the sternum, shoulders, arms, shoulder blades, and jaw angles. Facial scarring can affect up to 95% of patients, with a correlation between delaying active acne treatment and increased scarring severity.[1–4]

Residual acne scars pose a significant problem for patients, as they do not naturally resolve.[5–8] This issue is further compounded by the psychosocial implications associated with acne scars, such as frustration, depression, anxiety, and lowered self-esteem. Individuals with acne scars may fear that their appearance could impact their academic or professional pursuits, which brings additional concern, especially in the context of the prevalent use of social media. Classification of acne scars includes rolling, icepick, and boxcar categories.[4] Rolling scars exhibit smooth, wave-like indentations, while icepick scars are deep, narrow depressions. Boxcar scars are characterized by a flat, "u-shaped" base and appear round, polygonal, or linear on the skin's surface. The treatments available to minimize the visibility of scars should be tailored to individual patients based on the scar types presented. Resurfacing techniques, fillers, and dermal remodeling represent some of the therapeutic options for acne scar treatment, with laser treatment demonstrating effectiveness except for deep icepick scars.[9]

The LaserMe 1470 nm medical device, developed by Berger&Kraft Medical Sp. z o.o. in Poland, is meticulously designed to provide high-energy light therapy. Specifically engineered for use in dermatology, aesthetic medicine, general and plastic surgery, and cosmetology, this device administers monochromatic light directly to the skin to facilitate various therapeutic procedures. Its wide range of applications includes skin rejuvenation, skin tightening, transdermal drug delivery, reduction of enlarged pores, as well as the treatment of conditions such as scarring, encompassing acne scars and stretch marks. The device operates by emitting radiation in multi-millisecond pulses, maintaining a consistent power output. Essential parameters, including the energy density per pulse (adjustable between 5–50 mJ/point), pulse duration, and repetition frequency, are set by the operator. Notably, the LaserMe is a fractional, non-ablative laser featuring a 1470 nm wavelength diode with a maximum power of 2W, designed for fractional non-ablative skin resurfacing. As a result of LaserMe treatments, fractional columns are created within the dermis without disrupting the epidermis. Significantly, this device has exhibited a high safety profile, with no serious side effects observed, thereby ensuring a predictable and manageable postoperative course. Observations at the cellular level indicate that the LaserMe device is effective in treating scars, stretch marks, and skin laxity.[10]

The purpose of this study was to assess the safety and efficacy of employing a non-ablative 1470 nm laser for treating acne scars.

Materials and Methods

Selection of Study Population

40 healthy female volunteers aged 18 to 42 years (mean 26.2 years) experiencing acne scars on the facial skin were enrolled for the study. Each eligible patient received three 1470 nm laser treatments with two-week intervals. Exclusion criteria included: recent use of oral and/or local retinoids within six months prior to the study, excessive tanning, active skin and connective tissue diseases that exhibit photosensitivity (eg, systemic lupus, collagenopathy, cutaneous porphyria), current herpes simplex infection, intake of certain medications and/or photoreactive cosmetics (including tetracycline antibiotics, immunosuppressive drugs such as cortisone and its derivatives, anticoagulants such as dipyridamole and coumarin derivatives, cosmetics containing thyme extract, herbs containing St. John's wort) within six months prior to the study, conditions involving immunodeficiency after careful consideration by the qualifying doctors, uncontrolled diabetes, recent cosmetic or aesthetic procedures in the treated area as decided by the qualifying doctor, acquired vitiligo or other melanin production disorders, tattoos in the treatment area, or use of anti-inflammatory drugs. All participants provided informed consent. The study was conducted following the guidelines of the Declaration of Helsinki and was approved by the Ethics Committee of the Medical Chamber in Gdańsk, Poland (Reference: KB-(10)17/2023).

Assessment and Treatment Protocol

Participants in the study underwent 1470 nm laser treatment with an energy density of 28–35 mJ/point and a spacing of 0.8–1.2 mm at two-week intervals in the areas affected by acne scars. The effects of the treatment were measured employing cutometric measurements to determine the skin's elasticity in the treated area, clinical observations of patients, medical photographic documentation of the course after the procedures, and high-frequency ultrasound analysis of skin structure. Throughout the study, potential adverse effects were monitored. Data on measured indicators, including depth, diameter, and skin elasticity, were gathered before treatments, on day 21 (21 days after the first laser treatment), on day 42 (21 days after the second laser treatment), on day 70 (28 days after the 3rd treatment), and on day 130 (90 days after the end of treatments). Following the treatment, participants were instructed to prioritize photoprotection in the event of sun exposure by utilizing a broad-spectrum sunscreen with a minimum SPF of 50. Furthermore, it was recommended that they apply moisturizing emollient creams immediately after the treatment and continue this practice throughout the first week to facilitate the healing process and maintain optimal skin hydration. After one week, participants may resume their standard skincare routines, provided that the products chosen are gentle and non-irritating.

Statistical Analysis

The dataset was organized using Microsoft Excel™ and subsequently imported into IBM SPSS® version 29.0.1.0 and STATA® for statistical analysis. Continuous data were expressed as medians with ranges, while categorical data were summarized as frequencies and percentages. Normality of the distributions and homogeneity of variances were assessed using the Kolmogorov–Smirnov test and Levene's test, respectively. Differences in Skin Elasticity, Scar Depth, and Scar Width between the time points (Before Treatments, Day 21, Day 42, Day 70, and Day 130) were assessed using repeated measures ANOVA. All results were analyzed with an α significance level of 5%.

Results

After undergoing the procedure, the patients exhibited marked improvement in skin texture and reduction of acne scars (Figure 1). No adverse effects were observed, and all study participants continued their treatment without interruption.

Cutometric Measurements

The cutometric assessment was conducted using the Courage + Khazaka Multi Skin Test Center MC1000 device under standardized environmental conditions of 22–23°C temperature and 55–60% air humidity. The procedure for patient preparation was also standardized, involving makeup removal without the use of alcohol at least one hour before the measurement. The measurements were taken on the buccal skin area. Skin elasticity was evaluated on a scale of 1–100, where 1 represents the worst possible result and 100 the best. Three point-by-point measurements were taken each time to calculate an average result.

The mean skin elasticity before treatments was 62.95 (SD = 4.0). After 21 days following the first treatment, the mean elasticity increased to 63.72 (SD = 3.8), representing a 4% improvement from baseline with a p-value of <0.001. At 42 days post-treatment, the mean elasticity further improved to 67.11 (SD = 4.0), a 6% increase from baseline ($p < 0.001$). By day 70, 28 days after the third treatment, the mean elasticity reached 69.08 (SD = 4.2), showing an 11% improvement from baseline ($p < 0.001$). Finally, at day 130, 90 days after the end of treatments, the mean elasticity was 70.80 (SD = 4.4), reflecting a 14% improvement from baseline ($p < 0.001$) (Table 1, Figure 2).

High Frequency Ultrasound Evaluation

To assess scar sizes before and after treatment, high-frequency ultrasound was utilized. The depth and width of representative scars were evaluated, with at least one representative scar examined in each patient. The results are presented in millimeters with an accuracy of 0.01 mm. High-frequency ultrasound (Draminski, 48 MHz, Draminski Technology, Poland) was utilized for repeated measurements of two scars in each patient.

For scar depth, the mean depth before treatments was 0.19 mm (SD = 0.05). At 21 days post-treatment, the mean depth decreased to 0.18 mm (SD = 0.05), a reduction of 5% from baseline with a p-value of <0.001. By 42 days, the

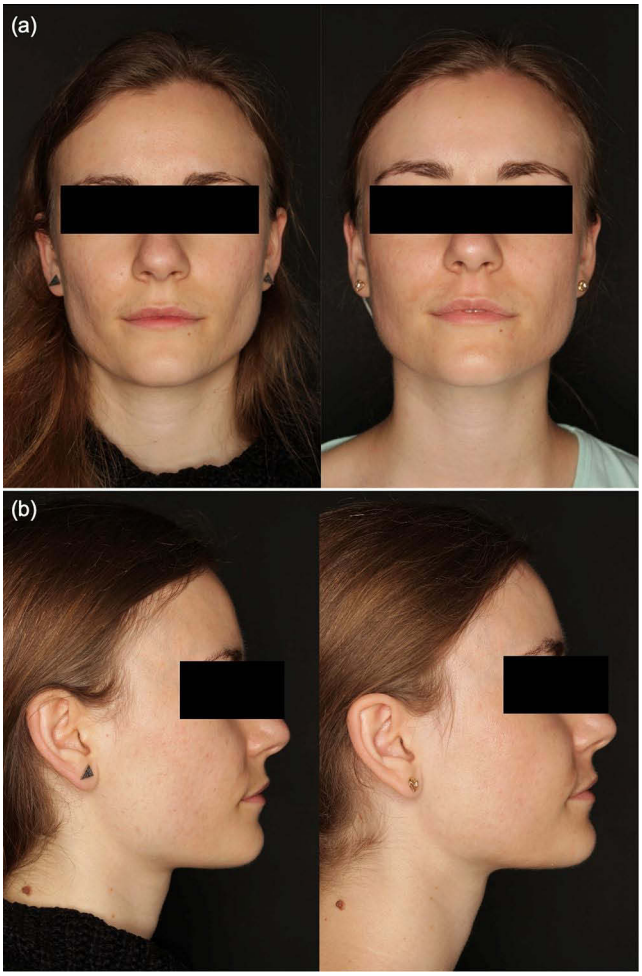

Figure 1 Pre-treatment (**a**) and post-treatment (**b**) photographs illustrating enhanced cutaneous texture and diminished acne scarring, observed at day 130 following 1470 nm non-ablative laser therapy.

mean scar depth reduced further to 0.15 mm (SD = 0.055), a 20% reduction ($p < 0.001$). At 70 days, 28 days after the third treatment, the mean depth was 0.10 mm (SD = 0.06), indicating a 48% reduction ($p < 0.001$). At 130 days, the mean depth was 0.07 mm (SD = 0.065), a 63% reduction from baseline ($p < 0.001$). These results show a significant decrease in scar depth over time, demonstrating the efficacy of the laser treatment (Table 2, Figure 3).

For scar width, the mean width before treatments was 3.66 mm (SD = 0.3). At 21 days post-treatment, the mean width reduced to 3.08 mm (SD = 0.3), a 16% reduction from baseline with a p-value of <0.001. By 42 days, the mean width

Table 1 Mean Skin Elasticity Variations During 1470 nm Laser Treatment

Time Point	Mean	Standard Deviation	Change vs Baseline	p-value
Before Treatments	62.95	4.0	-	<0,001
Day 21 (21 days after the 1st treatment)	63.72	3.8	+4%	<0,001
Day 42 (21 days after the 2nd treatment)	67.11	4.0	+6%	<0,001
Day 70 (28 days after the 3rd treatment)	69.08	4.2	+11%	<0,001
Day 130 (90 days after end of treatments)	70.80	4.4	+14%	<0,001

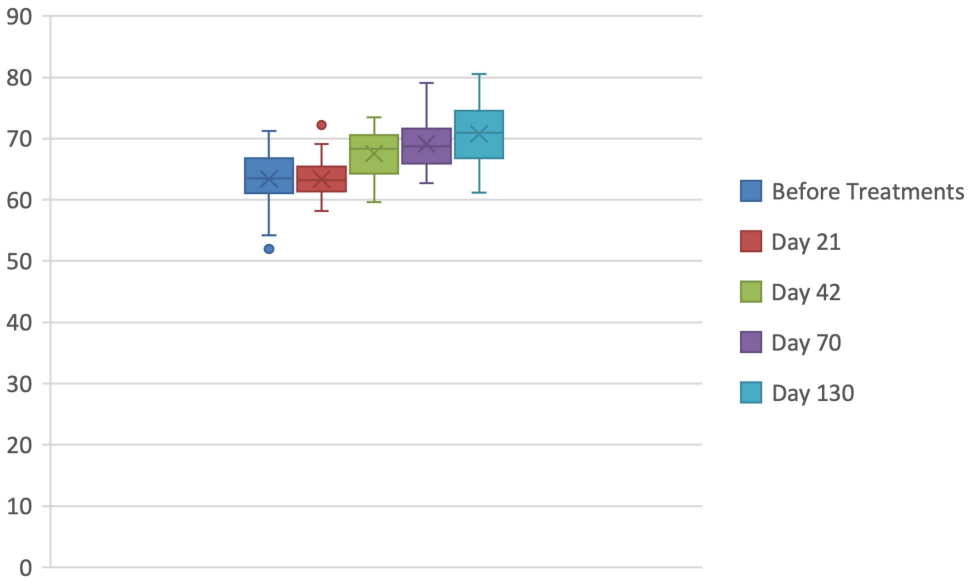

Figure 2 Skin elasticity variations during 1470 nm laser treatment.

further decreased to 2.71 mm (SD = 0.34), a 26% reduction ($p < 0.001$). At 70 days, 28 days after the third treatment, the mean width was 2.13 mm (SD = 0.36), showing a 42% reduction ($p < 0.001$). At 130 days, the mean width was 1.39 mm (SD = 0.38), representing a 62% reduction from baseline ($p < 0.001$). These results indicate a substantial reduction in scar width over time, corroborating the effectiveness of the laser therapy (Table 3, Figure 4).

Scar Diameter Comparison

Before treatments, the mean scar diameter was set as the baseline at 100%. After 28 days from the end of the treatments, the scar diameter reduced to 52.63% of the baseline. This represents a significant reduction, nearly halving the initial diameter, with a reduction percentage of 47.37%.

At 90 days after the end of treatments, the scar diameter further decreased to 36.84% of the baseline. This additional reduction over time suggests a continued improvement and remodeling of the skin, resulting in a total reduction percentage of 63.16% (Figure 5).

Discussion

Based on the findings, the 1470 nm non-ablative laser monotherapy proved to be effective in treating facial acne scars. This outcome aligns with previous findings that non-ablative lasers, which target water as the primary chromophore, can effectively stimulate dermal remodeling and collagen production without substantial epidermal damage.[11] The three laser therapy sessions using the tested device resulted in an average reduction of 45% in both diameter and depth of acne scars

Table 2 Mean Scars Depth Variations During 1470 nm Laser Treatment

Time Point	Mean	Standard Deviation	Change vs Baseline	p-value
Before Treatments	0.19	0.05	-	<0,001
Day 21 (21 days after the 1st treatment)	0.18	0.05	−5%	<0,001
Day 42 (21 days after the 2nd treatment)	0.15	0.055	−20%	<0,001
Day 70 (28 days after the 3rd treatment)	0.10	0.06	−48%	<0,001
Day 130 (90 days after end of treatments)	0.07	0.065	−63%	<0,001

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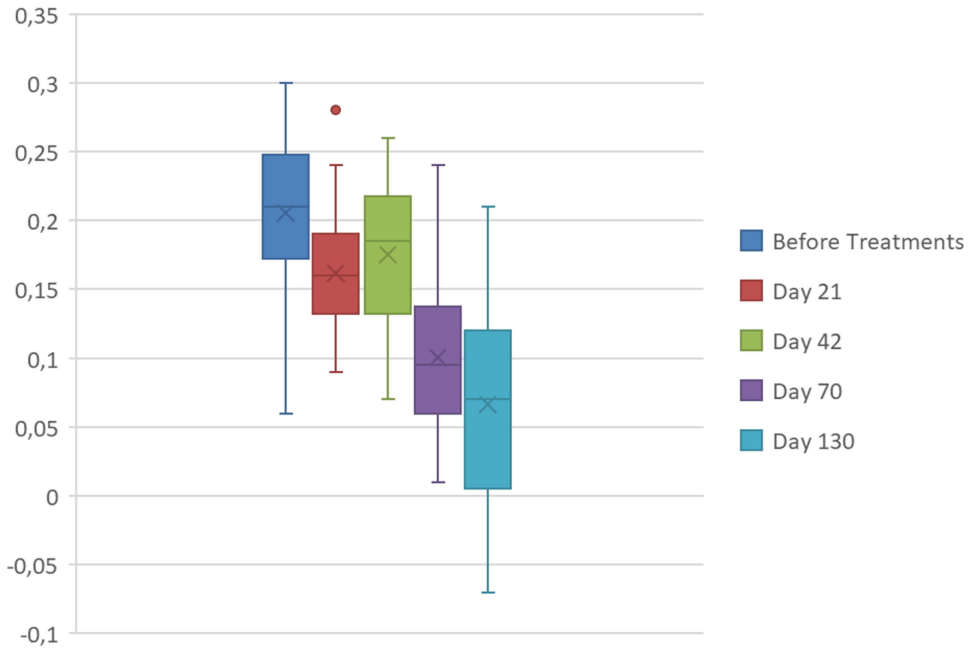

Figure 3 Scars depth variations during 1470 nm laser treatment.

28 days after the last treatment. This reduction further increased over time, reaching an average of 62% reduction in scar diameter and 63% reduction in scar depth 90 days after the treatment ceased, indicating a continuous process of skin remodelling. Statistical analysis of the data showed highly significant results with p-values less than 0.001 for improvements in skin elasticity, scar depth, and scar width. These significant p-values (<0.0001) underscore the reliability and robustness of the observed effects, confirming the treatment's efficacy. Macroscopic and microscopic evaluations of treatments with the tested 1470 nm laser device on healthy volunteers revealed a consistent and predictable skin healing process. The treatments formed fractional columns in the dermis while maintaining the continuity of the epidermis.[10] The tissue's biological response to the treatments was observed as columns of thermal impact with a small area of damage and a greater depth of non-destructive impact. The tissue surrounding and beneath these thermal impact columns remained unaffected, highlighting the safety profile of the tested device. This outcome aligns with the concept of fractional laser therapy, aiming to induce targeted tissue damage while preserving the surrounding healthy tissue.[10,12] The tested device exhibited a noteworthy safety profile, with no serious side effects reported during the trials. Observations of the treatment mechanisms indicate a predictable and controllable postoperative course. This predictability allows for better patient outcome management, ensuring that the healing process proceeds as anticipated. The absence of significant adverse effects further underscores the suitability of the device for clinical use, instilling confidence in both practitioners and patients regarding its reliability and effectiveness. Targeting water as the chromophore, non-ablative fractional lasers can be used for all skin types. These devices were the first type of fractional lasers designed to create narrow (sub-millimeter) and widely spaced columnar thermal wounds at a depth and density chosen by the operator. Non-ablative

Table 3 Mean Scars Width Variations During 1470 nm Laser Treatment

Time Point	Mean	Standard Deviation	Change vs Baseline	p-value
Before Treatments	3.66	0.3	-	<0,001
Day 21 (21 days after the 1st treatment)	3.08	0.3	−16%	<0,001
Day 42 (21 days after the 2nd treatment)	2.71	0.34	−26%	<0,001
Day 70 (28 days after the 3rd treatment)	2.13	0.36	−42%	<0,001
Day 130 (90 days after end of treatments)	1.39	0.38	−62%	<0,001

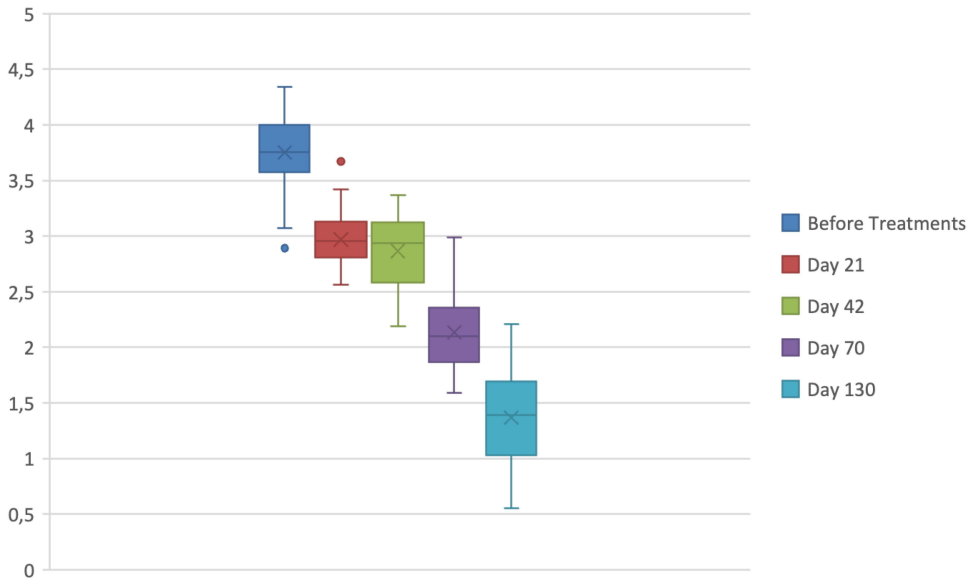

Figure 4 Scars width variations during 1470 nm laser treatment.

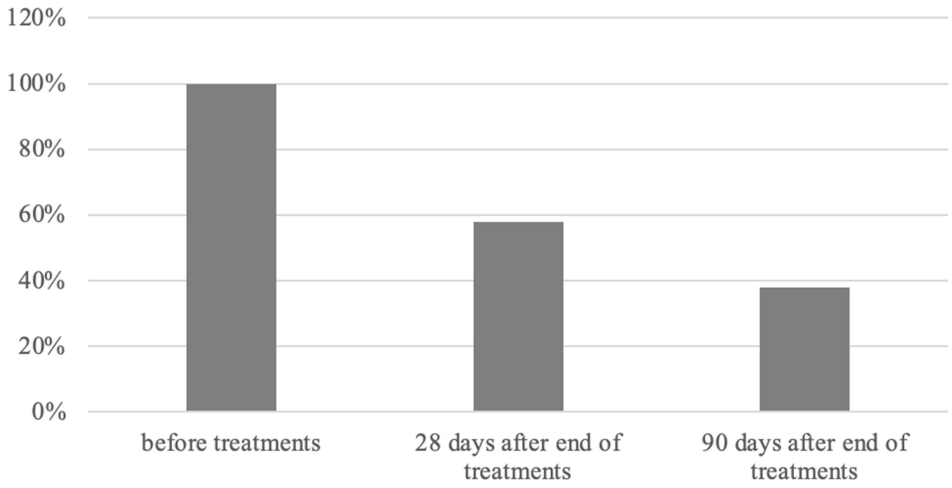

Figure 5 Scars diameter comparison after three treatments.

fractional lasers for treating atrophic acne scars have gained popularity due to perceived increased tolerability for darker skin types and reduced associated downtime compared to ablative systems.[13] The variation in fluence is critical for optimizing treatment outcomes across different types of scars. Elevated fluence levels can produce significant thermal effects within the dermis, which are vital for enhancing collagen remodeling and promoting neovascularization, both of which contribute to improved scar appearance and skin texture. For atrophic scars, a moderate fluence is typically adequate to achieve the desired clinical outcomes by stimulating new collagen synthesis while minimizing the risk of excessive thermal damage that could exacerbate scarring. Conversely, for hypertrophic scars or keloids, a precisely controlled higher fluence may be necessary to effect meaningful change, addressing the abnormal collagen bundles and facilitating their realignment.[14]

Conclusion

The presence of acne scars is a common concern for many individuals affected by acne vulgaris. It is essential to address scar treatment as a significant aspect of overall care, in addition to primary treatments aimed at reducing inflammatory

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and non-inflammatory lesions. Acne, like other chronic dermatological conditions, has been shown to significantly impact patients' quality of life, often affecting their emotional well-being, self-esteem, and social interactions.[15–17] The psychological impact of scars on self-esteem, in conjunction with their prevalence, motivates many patients to seek treatment options for enhancing their appearance. The initial step in tackling acne scars involves addressing any lingering redness, followed by targeting generalized atrophic scars and tailoring the treatment approach to the specific type of scar. Subsequently, remaining scars should be treated with the most appropriate method for each distinctive scar. For individual scars, surgical techniques and cross-linked hyaluronic acid-based products may prove effective. Yet, a more comprehensive treatment is often necessary, especially for extensive scars. In such cases, lasers and other resurfacing methods continue to be the primary treatment options. A personalized and methodical approach, tailored to each patient and their specific type of acne scars, yields optimal cosmetic results and enhances patient satisfaction.[18]

Non-ablative lasers represent a critical therapeutic option in the treatment of acne scars. Their key advantage lies in their ability to target both discoloration abnormalities and skin texture issues. To achieve favorable outcomes, it is imperative to comprehend the pathophysiology of acne lesions, as well as the mechanisms and clinical effects of each therapeutic method, including lasers. This understanding is crucial in selecting the most suitable device and technique for optimizing treatment outcomes for each patient. Given their capacity to address pigmentation issues and textural irregularities, lasers are a vital option for managing acne scars.

The significant p-values (<0.0001) observed in this study highlight the strong statistical support for the efficacy of the 1470 nm non-ablative laser treatment. These findings provide a solid foundation for the use of this therapy as a reliable and effective option for patients seeking to improve the appearance of acne scars.

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Disclosure

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