Annals of Case Reports
Avdulaj A. Ann Case Rep: 9: 101602
www.doi.org/10.29011/2574-7754.101602
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Research Article

Skin Laxity Treatment Using Near Infra-Red: Clinical Results in 30 Women

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Citation: Arminda Avdulaj (2024) Skin Laxity Treatment Using Near Infra-Red: Clinical Results in 30 Women. Ann Case Report 09: 1602. DOI: 10.29011/2574-7754.101602.

Received Date: 17 December 2023; **Accepted Date:** 16 January 2024; **Published Date:** 22 January 2024

Abstract

Background: The use of minimally invasive aesthetic treatments to reduce the signs of aging has gained popularity over surgical therapies in recent years. Near Infrared (NIR) offers a safe, non-ablative alternative for skin rejuvenation, providing both thermal and non-thermal properties. **Aims and Objectives:** Here, we report a study to evaluate the efficacy and safety of using a NIR module for immediate improvement in skin tone without the need for recovery. **Materials and Methods:** Thirty healthy women received one treatment session for skin laxity using a NIR module. Improvement was assessed by the physician using the Global Aesthetic Improvement Scale (GAIS) and satisfaction was assessed by the patients using a Likert scale. The relationship between smoking status and treatment outcomes was also evaluated. Pain and side effects were monitored. **Results:** The mean GAIS score was 8.1 ± 0.5 (mean ± SD) and the mean patient satisfaction score was 8.0 ± 0.7 (mean ± SD). There was a strong positive association between physician assessment and patient satisfaction (r=0.62). The t-test indicated no statistically significant difference between the measures (p-value=0.42). There was no significant association between smoking status and treatment outcomes, (p-value = 0.82). No pain or adverse events were reported. **Conclusion:** This study demonstrates the safety and efficacy of NIR treatment for immediate improvement in skin appearance.

Keywords: Near-Infrared; Non-Ablative; Non- Invasive; Cosmetic Dermatology

Introduction

The process of skin aging, which manifests as pigment abnormalities, wrinkles, and skin laxity, is determined by both genetic and environmental factors. Genetic factors contribute to decreased production of proteins in the dermal extracellular matrix as dermal fibroblasts age. Environmental factors are mainly related to prolonged exposure to radiation from the sun, which promotes the degradation of collagen fibers [1] leading to reduced skin elasticity and ultimately the formation of fine lines and wrinkles [2,3]. The effects of sun exposure on the skin have been studied extensively, and it is well known that Ultraviolet (UV) radiation has enough energy to break chemical bonds and cause photochemical reactions that can lead to skin cancer, aging, and weakening of the immune system. In contrast, the effects of Infrared (IR) radiation on humans have been less studied. The influence of Near-Infrared (NIR) radiation, which accounts for 54.3% of the solar radiation reaching the Earth, has been found to have a dual effect on the skin, beneficial up to a certain threshold and potentially harmful beyond [4].

In cosmetic dermatology, resurfacing treatments that use light energy are designed to intentionally cause controlled damage to the skin to stimulate new collagen formation and promote skin rejuvenation [3,5]. These treatments are classified as either ablative or non-ablative. Ablative skin resurfacing, considered the gold standard in skin rejuvenation, involves the removal of the epidermis and partial thickness of the dermis to achieve skin rejuvenation. However, these procedures are painful, carry risks, and often require a lengthy recovery period. Non-ablative therapies induce thermal damage in the dermis, subsequently initiating a cascade of inflammatory events, including fibroblast proliferation and upregulation of collagen expression, resulting in skin tightening and improvement of skin laxity [2]. Although limited in efficacy, the non-ablative strategy, which includes laser, light, and radiofrequency devices, is associated with reduced risk and shorter recovery time [1]. The healing benefits of Near-Infrared (NIR) light on humans have been well documented in the literature [4], and early data indicate that it provides immediate skin tightening with a short recovery time and minimal risk [6].

The current retrospective cohort study examines the use of a NIR module for immediate but temporary improvement in skin tone without the need for recovery. We aim to evaluate whether the procedure is a safe and effective solution for patients who are willing to accept modest improvement in exchange for minimal downtime and risk.

Materials and Methods

Clinical Data

This is a report of a retrospective cohort of patients routinely treated for skin laxity on the face and neck at the Klinika Mjekësore San Luca, Tirana, Albania. The study was conducted from January 2022 to April 2023 and was approved by the Ethics Committee of the Albanian Ministry of Health (ethics number: AA-2021-01).

Informed consent for publication of results was obtained from all patients whose data are used in this report. Records of Fitzpatrick skin types II-III patients who had facial or neck skin laxity and were healthy with no major underlying medical conditions were included in the study. Data collection was conducted anonymously, including patients' demographic and treatment characteristics such as gender, age, treatment areas, immunosuppression or other systemic disease, and smoking status. Reasons for exclusion included skin conditions or medications that could interfere with treatment; previous treatments to the same area(s) at least six months before the NIR treatments; skin type VI; pregnant, planning to become pregnant during the study, less than three months postpartum, or less than six weeks postpartum; sun exposure or artificial tanning in the 3-4 weeks before treatment. Any residual sun damage, sunburn, or artificial tanning products; active infections in the treatment area; chronic or cutaneous viral, fungal, or bacterial diseases; tattoos in the areas to be treated.

Patients were instructed to avoid topical creams for veins or pigmented lesions, to limit sun exposure, and to use sunscreen with SPF 50 or higher for the duration of the study.

Treatment procedure

Each patient received one treatment per treatment area using the NIR face applicator (Harmony XL Pro, Alma Lasers, Caesarea, Israel) with a pulse width of 6.4 cm2, a peak emission of 1300 nm, and a fluence of 20-25 watts in a continuous mode. The treated areas were photographed before, during, and after treatment, and all patients were followed for one week after the treatment.

Clinical evaluation

The physician who performed the treatment also evaluated effectiveness at the end of the treatment, as compared to the pre-treatment photos. The Global Aesthetic Improvement Scale (GAIS), which ranges between 0- and 10 (0 – no improvement, 10 – maximum improvement), was used for grading of change in the target site appearance.

In addition, patients were requested to rate their satisfaction with the treatment outcome at the end of the treatment. Satisfaction was graded on an 11-point Likert scale (0 – maximum dissatisfaction, 10 – maximum satisfaction).

Patients were requested to self-assess the pain associated with the treatment immediately after the treatment. An 11-point scale questionnaire was given to the patients to communicate their pain perception, ranging from 0 (no pain) to 10 (severe pain).

Adverse events were monitored during the treatment and at an additional one-week follow-up visit.

Statistical analysis

Descriptive statistics summarize patient characteristics. The Pearson correlation test was used to analyze the relationship between physician assessments and patient satisfaction scores, and a two-sample t-test was used to determine whether there were significant differences between them. A chi-squared test was used to examine possible associations between smoking status and treatment outcomes. Analyses were performed using the Microsoft Excel Data Analysis Tool. The significance level was set at $\alpha=0.05$.

Results

Thirty eligible patients treated with NIR for skin laxity on the face and/or neck were included in this retrospective data collection study. Patients' demographic characteristics are presented in Table 1

Characteristics*	
Patients (all female)	30
Age (years)	
Min, Max	21,56
Mean ± SD	37.3 ± 9.6
Smoking status	
Smoking	24
Non-smoking	6
Fitzpatrick skin type	
Skin type II	9
Skin type III	21
Body area	
Face	25
Face and neck	5
* Values are presented as total or mean ± Standard Deviation (SD)	

Table 1: Patients' Demographics

The mean GAIS score assessed by the physician at the end of the treatment was 8.1 ± 0.5 (mean ± SD) and the mean patient satisfaction score was 8.0 ± 0.7 (mean ± SD). Figure 1 shows the percentage of patients distributed along the GAIS scale and the patient satisfaction scale.

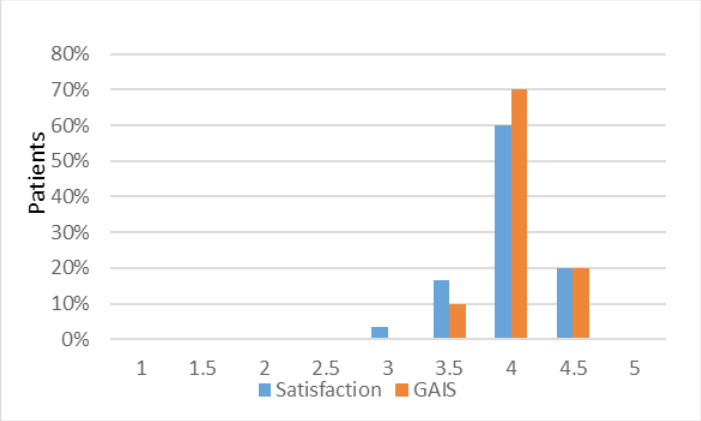

Figure 1: Patient satisfaction scores and physician assessment GAIS scores, at the end of the treatment.

Analysis of treatment efficacy revealed a strong positive association between physician assessment and patient satisfaction, with a Pearson correlation coefficient of 0.62. The t-test yielded a calculated p-value of 0.42, indicating no statistically significant difference between physician assessment and patient satisfaction. Improvement of skin tightening was well seen (Figure 2-4).

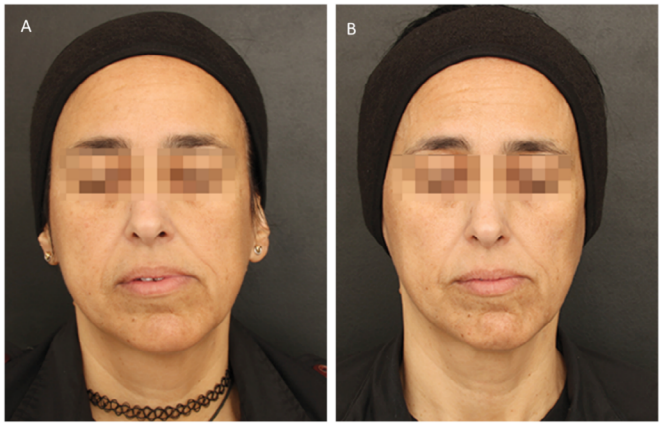

Figure 2: Skin tightening effect observed in a 54-year-old patient, skin type III, before (A) and one week after the NIR treatment (B)

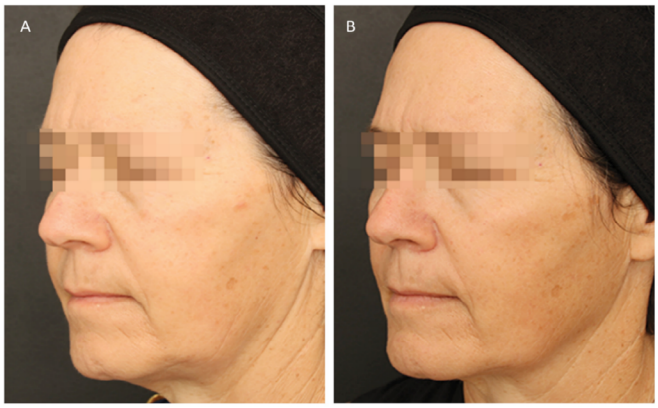

Figure 3: A skin tightening effect was observed in a 60-year-old patient, skin type II, before (A) and one week after the NIR treatment (B).

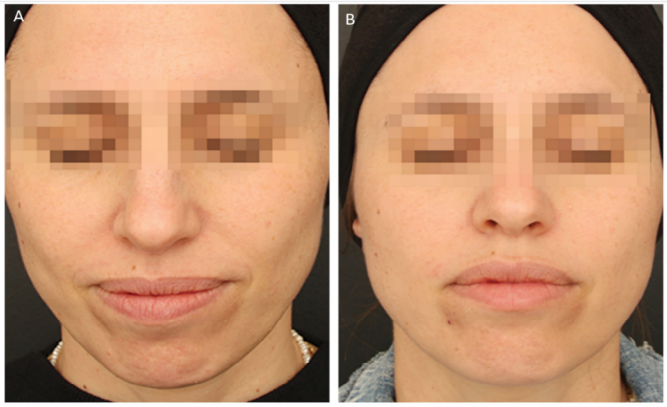

Figure 4: A skin tightening effect was observed in a 35-year-old patient, skin type III, before (A) and one week after the NIR treatment (B).

The potential association between smoking status and treatment outcome was examined using a chi-squared test. The group was categorized according to a defined threshold of 8 on the GAIS scale, based on the mean GAIS score of 8.1. This categorization allowed us to assess whether smoking was correlated with GAIS scores that deviated from the mean. For nonsmokers, the expected and observed frequencies of GAIS scores above 8 were 4.8 and 5, respectively, while for GAIS scores of 8 or less, they were 19.2 and 19. For smokers, the expected frequencies were 1.2 for GAIS scores above 8 and 4.8 for GAIS scores of 8 or less, with corresponding observed frequencies of 1 and 5. The chi-squared statistic of 0.0521 indicates minimal divergence between observed and expected outcomes, and the associated p-value of 0.82 indicates no statistically significant difference in treatment outcomes with respect to smoking status.

All patients reported no pain during treatment and no adverse events were observed during the treatment or at the one-week follow-up.

Discussion

There is a growing demand for effective skin rejuvenation therapies with minimal side effects and short recovery times. Ablative and non-ablative rejuvenation modalities each have their strengths and limitations [1]. Table 2 shows a comparison between the different types of treatments.

	NIR	Q-switched NdYag (ClearLift)	SoftLift (1570 nm)	Nonablative Co2 (Termotight)	RF	Profhilo (non reticulated hyaluronic acid)	Botulinum toxin type A (Botox)	Ablative CO2
Number of treatments	1	2-6	3	2-4	6	1-3	1	1
Lasting of results	1 week	3 months or more	4-8 months	1-2 months	3 months	3-6 months	4-6 months	1 year
Adverse effects	N/A	N/A	Redness (hours), pain	N/A	Pain, burning sensation	Pain, temporary bumps	Pain, hematoma	Crusting for 4-5 days
Time to see the results	Immediate	2-3 weeks	1-2 weeks	1 week	1-4 days	4 weeks	3-14 days	6 weeks
Recovery time	None	None	Hours	None	None	Hours	None	4-6 days

Table 2: Ablative and non-ablative rejuvenation modalities comparison

Infrared (IR) and radiofrequency devices, both non-ablative rejuvenation modalities known for their minimal downtime, have proven effective in reducing skin laxity [7,8]. Radiofrequency is a non-ionizing radiation at the low energy end of the electromagnetic spectrum. Radiofrequency devices can be classified as monopolar, bipolar, or multipolar [9], with monopolar RF systems providing homogeneous heat distribution, making them an effective choice for treating skin laxity [9,10]. However, they are often associated with increased patient discomfort, as well as the potential risk of rare fat necrosis and scarring when used at high fluences [8].

IR, non-ionizing radiation, is divided into Near IR (NIR) at 760-3000 nm, mid-IR at 3000-30,000 nm, and far IR at 30,000 nm-1 mm [10] and in general, is highly absorbed by hemoglobin and water. During infrared irradiation, to protect deeper tissues, the body increases absorption by hemoglobin and water through vasodilation. Similarly, it increases the water content of the dermis by inducing higher levels of collagen, elastin, and water-binding proteins [7].

NIR tends to efficiently reach subcutaneous layers without causing severe surface temperature elevation and pain [1,2,11,12]. Similar to radiofrequency, it induces skin tightening through deep tissue heating [2]. Dermal heating initiates a cascade of inflammatory events, including fibroblast proliferation and upregulation of collagen expression, resulting in skin tightening and improvement of skin laxity. In addition, NIR non-thermally relaxes and weakens dystonic or hypertrophic muscles, which is effective in reducing wrinkles [2]. Previous studies have reported equal or superior results with NIR compared to radiofrequency devices [8].

While chronic infrared exposure contributes to photo aging [10], the literature suggests a single dose of infrared for up to 48 hours can have a beneficial effect [13].

In one interesting study, a single NIR exposure to human skin was found to increase type I procollagen expression, whereas repeated NIR exposures three times a week for four weeks decreased type I procollagen levels [14]. Other studies further support the safety and efficacy of infrared treatment. In a prospective, single-blind, split-face study of 13 Chinese women treated with an infrared device for skin tightening, the treated side showed significant improvement compared to the untreated side, with only one case of self-resolving blistering [15]. In another study, 20 Japanese patients were treated with a near-infrared device; 85% of patients reported satisfaction with the improvement of skin laxity, and 80% of patients reported satisfaction with the improvement of rhytids. No side effects were observed throughout the study [2]. In addition, in a study of 12 women, with an average age of 64, treated with infrared for skin laxity, clinical improvement was seen in 11 of 12 patients, with no complications reported [8]. The immediate effect of NIR treatment was also evident in histologic analysis, which showed rapid post-treatment structural disruption of dermal collagen and elastin without epidermal disruption, which also correlated well with previous histologic evaluation of cadaver skin biopsies immediately following infrared treatment [16].

The use of NIR light appears to be an effective strategy to promote wound healing, induce anti-inflammatory effects, and complement dermatologic treatments. The photochemical changes that occur when NIR light interacts with a photoreceptor molecule called cytochrome c oxidase, located in the mitochondria of human cells, have been compared to the process of photosynthesis in plants [4].

In this study, treatment with the NIR device was performed at a wavelength of 1,300 nm, avoiding wavelengths of 1,400-1,500 nm to prevent vasodilation and target deeper tissues with minimal pain and risk of epidermal burns. This is based on the principle that wavelengths below 1100 nm are primarily absorbed by melanin at the skin surface, and wavelengths between 1400-1500 nm and above 1850 nm are primarily absorbed by water, thereby heating the skin surface [7].

The treatment was designed to provide an immediate tightening and firming effect with minimal downtime for individuals seeking a quick facial enhancement, ideally targeted before special events. Consistent with prior research, the majority of patients in this study showed significant improvement after one treatment, which was also consistent with patient satisfaction. The treatment was safe, with no adverse events or pain reported. As mentioned in a previous study, several factors may limit the visual effect, including a small amount of excess skin, the underlying tissue structure, and the resistance of dense fat deposits [8], which should be discussed with the patient prior to treatment. Smoking was not found to affect the results in this study. This should be further established in a larger cohort in a comparative setting.

Limitations include the retrospective design of the study, a relatively small cohort, a limited range of skin phototypes, and an all-female cohort, which may reduce the overall relevance of the study in a broader context. While the results of the current study are in agreement with existing research, randomized controlled trials with larger and more diverse populations are warranted to confirm this conclusion further.

Conclusion

Overall, the results of this study support the high safety profile and immediate improvement in skin appearance of NIR treatment for skin laxity and are consistent with previous research. Managing patient expectations is critical, and ideal candidates for this procedure are those who desire immediate improvement in appearance and a quick recovery or those who prioritize minimal discomfort.

Acknowledgments

The authors would like to acknowledge the valuable assistance of Ms. Livnat Elfassi in patients' recruitment and treatment procedures, and the important editorial assistance of Ms. Merav Cohen.

Ethical Guidelines: This is a retrospective collection of anonymized data from previously recorded routine assessments and does not present a risk of exposure to patients' personal data. Waiving informed consent will not adversely affect the rights and welfare of the subjects. Consequently, informed consent is not required, in agreement with the Albanian law.

Conflict of Interest: The authors declare no conflict of interest.

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