Non-Fractional Broadband Infrared Light for: **Acne Scarring** - Preliminary Results

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Summary

Background: Acne is a common condition that may result in permanent, disfiguring scars. Over the past several decades, numerous surgical and non-surgical techniques have been used to improve the appearance of scars. Recently non ablative light or laser therapy have been proposed to improve the appearance of acne scars, making it an ideal method for patients seeking a minimal invasive procedure with an excellent safety profile.

Objective: To prove the ability of a novel system emitting non-fractional controlled broadband near infrared light (Novaplus, Ultramed, Geneva, Switzerland) for non-invasive skin tightening by deep dermal heating and fibroblast stimulation.

Material and Methods: Twenty volunteers were treated four times with a two-week interval between treatments. Near infrared light in the 800 nm to 1.800 nm part of the spectrum was applied in doubled chopped pulses at an average fluence of 28 J/cm². Clinical photography and three-dimensional in vivo optical skin imaging was conduced at baseline and two weeks and three months after the fourth treatment for evaluation of the skin tightening effect. Scar depth was measured with a 3d-profilometry attached computer soft ware (Aphrodite®).
Results: Two weeks after the forth treatment the average value of the scar depth measured by 3d profilometry changed from 738,4 μ to 587,2 μ; three months after the value of the same scar for each subjects showed an improvement up to 416,7μ. No adverse effects were documented and global standard of compliance could be considered good.
Conclusion: Non-Fractional controlled broadband near infrared light (800 nm to 1.800 nm wavelength) is a safe and effective novel approach to non-invasive skin remodelling which consistently determines an improvement of depressed acne scars. Key words: infrared light, broadband, non-invasive, skin remodelling, acne scars.

Introduction

Acne is a common disorder that may result in permanent scars. Recently a simple and universally applicable classification system has been proposed for acne scars, which have been divided into 3 basic types: Icepick scars, rolling scars and boxcar scars (1) Icepick scars are narrow, deep, sharply emarginated epithelial tracts that extend vertically to the deep dermis or subcutaneous tissue. Their depth is below that reached with conventional skin resurfacing options and complete recovery is usually impossible.

Rolling scars occur from dermal tethering of skin. Abnormal fibrous anchoring of the dermis to the subcutis leads to superficial shadowing and a rolling appearance to the overlying skin. Although they tend to be shallow, the sub dermal tether precludes treatment from the surface above. Correction of the sub dermal component is essential for treatment success.

Boxcar scars are round or oval depressions with sharply demarcated vertical edges. They are clinically wider at the surface than icepick scars; they may be shallow (0.1-0.5 mm) or deep (>0.5 mm). Shallow boxcar scars are within the dermal reach of skin resurfacing treatments, but deeper boxcar scars do not improve in absence of a full thickness treatment technique.

A variety of approaches are available for revision of each of the 3 scar types. Most of them are surgical or invasive procedures that may have a long and unacceptable downtime for some patients (2). Moreover all resurfacing treatments usually require a sub surfacing "filling" to correct the depression. One of the newest trends of scar treatment has been the development of no ablative light or laser systems that determine a collagen remodelling effect that can achieve a consistent improvement of depressed acne scars. In our study we have proven the ability of a novel system emitting non-fractional controlled broadband near infrared light (Novaplus, Ultramed, Geneva, Switzerland) for non invasive skin tightening by deep dermal heating and fibroblast activation.

Material and Methods

Study design

20 volunteers (13 females, 7 males) aged 25 to 43 years were recruited. All of them wanted improvement of their depressed acne scarring. All patients had different kinds of depressed scars on their face, but icepick scars were not considered in our study, . All participants before the first treatment gave informed consent. Standardized digital picture assessment and three-dimensional in vivo optical skin imaging (3D-profilometry) of one selected scar was performed at baseline, 15 days and three months after the last treatment. Scar depth was measured by a 3d-profilometry attached computer soft ware (Aphrodite®). Treatments of both cheeks and chin (according to the area where scars were evident) were conducted without use of any anaesthetic.

Non-fractional Infrared light source

A new concept of non-fractional controlled broadband light (Novaplus, Ultramed, Geneva, Switzerland) emitting at three different sections of the light spectrum: i) 800 to 1.800nm near infrared, for deep dermal heating and fibroblast stimulation; ii) 500 to 800nm, for the treatment of vascular lesions; iii) 600 to 1.000nm, for hair removal and for improvement of pigmented lesions. The energy densities that may be applied range from 10 J/cm^2 to 45 J/cm^2. The light pulses may be applied in differently chopped modes at durations of 5 ms to 3.000 ms. All types of application use the same hand piece using a spot size of 6 cm^2 (40x15mm) with no need of filters. To avoid epidermal injury contact cooling is integrated in the hand piece, being able to cool the skin surface down to minus 5^{0}C to +5^{0}C (+5^{0}C used in routine treatments).

For skin tightening infrared light from 800

nm to 1.800 nm can be applied in pulses at fluence from 21 J/cm² to 45 J/cm². At increasing fluencies the pulses may cause a burning sensation in the dermis, therefore in most cases 28-31 J/cm² were used as they were tolerated by the patients without local anaesthesia. The particular burst mode, which can be modified by a simple operation on the software, chops the pulse into a series of mini pulses. Burst pulse widths are of 3 ms to 6 ms, with 20 ms interval between pulses at 0.5 Hz.

Results

All investigators on the basis of standardized clinical pictures undertook a subjective analysis individually. The analysis was undertaken preoperatively and 2 and 12 weeks postoperatively. A significant improvement of the scars was observed by all of us, but grading the improvement was extremely difficult. Moreover, we should expect a clinical improvement continuing for 6 months or more after the treatment.

It is clear that an independent, unbiased observer would be more beneficial to analyse objective data.

Three-dimensional in vivo optical profilometry was used to analyse the effects of the treatment protocol. In Table I results are reported. At baseline the median value of the selected scar depth by using a 3d-profilometry attached computer soft ware (Aphrodite®) was 738,4µ Two weeks after the forth treatment the median of the same scar depth for each patient was 587.2µ. After 3 months the median of the same scar measured 416,7µ.

Statistical analysis of the data according to Anova with 65repeated measure tests showed high significance of improvements.

Discussion

The concept of skin remodelling through non-ablative light sources has developed rapidly during the last few years. It is widely accepted that these treatments should be integrated in daily practice to take care of the cutaneous aging process, but only a few reports exist regarding the possibility to treat with the same concept depressed acne scars. From a biological point of view the concept of collagen remodelling which is the goal of every skin rejuvenation treatment could be also be applied for acne scar depressions. Moreover we should consider that the treatment of acne scars is often frustrating even with more invasive modalities, like laser resurfacing or subcutaneous incision, with major pain and long down time for the patients. Expectations are usually not achieved with a not satisfactory global compliance. Non-ablative skin tightening has the advantage to be relatively painless, with no risks of adverse reactions and with no down time. Various light sources have been encountered stimulating fibroblasts to produce new collagen. Clinical research was busy to evaluate the benefits of different methods dealing with innumerable systems. [3, 4, 5]

Improvement in the appearance of photo damaged skin after treatment with most these devices is associated to a sub-threshold light induced injury to the dermis and/or the dermal vessels, which leads to a wound-repair response, characterized by fibroblast stimulation and new collagen production. Judgement of the results that have been gained with these efforts was not always easy and by far not always significant. [6] Objective methods for the evaluation of the clinical results had to be found in order to give

prove of the benefit of non-invasive surface remodelling. [7]
This study was designed to prove that non-fractional broadband near infrared light of a certain intensity applied in chopped pulses will improve the clinical appearance of atrophic acne scars. Three-dimensional in vivo optical skin imaging provided a rapid and quantitative assessment of skin surface of acne scars before and after four treatment sessions. The results of our study showed high statistical significantly (Anova repeated measure test). Patients should be informed that the collagen remodelling response is delayed and that maximum results are seen only after 3 months or even more, but the relatively simple and acceptable procedure lead them willing to participate to a long term program of skin recovery.

Conclusion

The results of this pilot study suggest that non-fractional controlled broadband near infrared light (800 nm to 1.800 nm wavelength) applied in chopped pulses at a fluency of 28 to 31 J/cm^2 is a safe and effective novel approach to non invasive skin treatment of acne scars. Further controlled studies with larger numbers of patients, perhaps a larger number of treatment sessions, and a longer follow up period are necessary to establish the exact mechanism of action of infrared light in skin collagen remodelling.

Results of 3 d optical profilometry on 20 patients with acne scarring

BASELINE	15 days after the treatment	3 months after the treatment
736	704	564
936	616	504
664	568	496
744	608	552
624	360	328
768	584	285
816	176	112
624	520	464
1008	896	736
856	648	592
424	464	176
976	792	584
832	704	300
592	512	348
544	520	456
592	464	392
960	888	352
760	648	345
760	608	472
552	464	276
738,4	587,2	416,7

ANOVA REPEATED MEASURES: F= 311,705 sig. .000 Computed using α= .05

Acne scarring of a patient before treatment

before

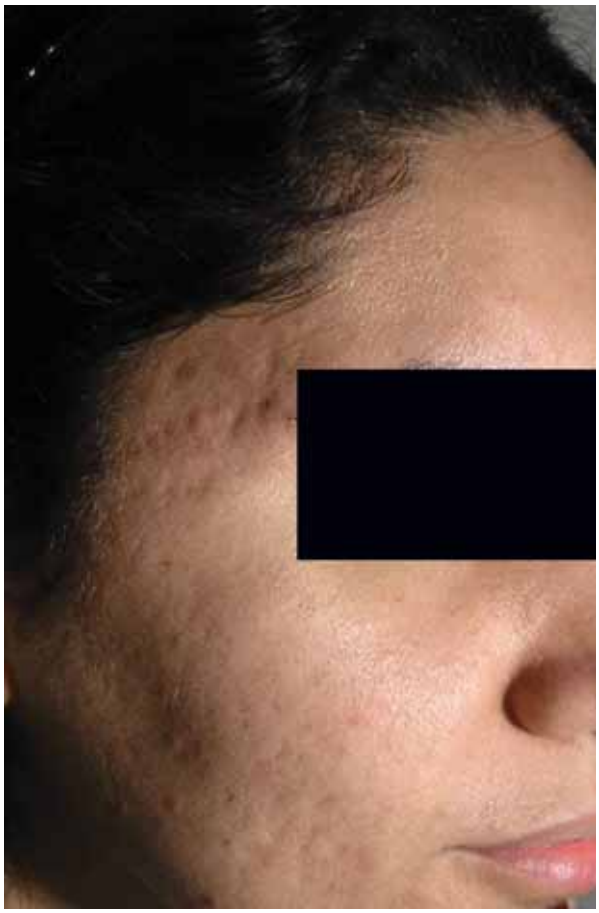
after

Improvement of acne scarring 15 days after the treatment.

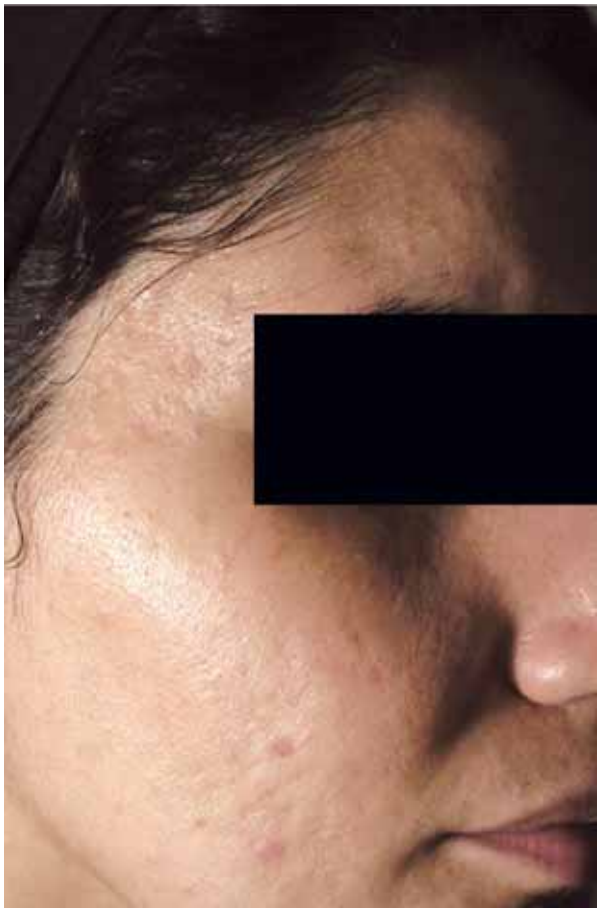
before

after

Acne scarring of a patient before treatment



before



after

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