

The effective treatment of acne vulgaris by a high-intensity, narrow band 405–420 nm light source

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BACKGROUND: Available topical treatments are slow and frequently irritating. Oral therapies may be associated with increased bacterial resistance (antibiotics) or possible severe side effects (oral isotretinoin). *In vitro* and *in vivo* exposure of acne bacteria to 405–420 nm ultraviolet (UV) free blue light results in the photo-destruction of these bacteria through the effects on the porphyrins produced naturally by *Propionibacterium acnes*. A novel, high-intensity, narrow band 420 nm UV free blue light has been shown to decrease inflammatory acne lesions after eight bi-weekly treatments.

OBJECTIVES: To examine the effects of high-intensity, narrow band 420 nm UV free blue light (ClearLight[™]) on inflammatory acne lesions.

METHODS: Three studies were carried out to examine the clinical effects of high-intensity, narrow band blue light on papulo-pustular acne: the split-face dose-response study, the

full-face open trial and the split-face, double-blind controlled study. The studies enrolled 10, 13 and 23 patients respectively.

RESULTS: The data show more than an 80% response to 420 nm acne phototherapy with a significant reduction of 59–67% of inflammatory acne lesions after only eight treatments of 8–15 minutes. The reduction in lesions was steady in the follow-ups at 2, 4 and 8 weeks after the end of therapy. Prolonged remission was evident in the 8 weeks after the end of therapy. No adverse effects or patient discomfort were noted in any of the patients.

CONCLUSIONS: Acne phototherapy by high intensity, narrow band 405–420 nm light is proven to be an attractive, fast, effective, non-invasive alternative to current topical and parenteral anti-acne remedies.

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Introduction

Acne is a condition of the sebaceous glands that affects 80% of the human population. Acne usually starts in adolescence when hormonal changes cause the enlargement and then the obstruction of sebaceous glands in the skin. The obstruction of the glands' openings cause the accumulation of sebum, which is followed by abnormal proliferation of bacterial population, predominantly

Propionibacterium acnes. *P. acnes* attracts inflammatory cells and thus the unsightly red, painful pustules of acne are formed. These same lesions potentially heal with permanent scarring.

In spite of various available treatments for acne, there are many patients who fail to respond adequately or who develop problematic side effects.¹ Topical acne medications are usually irritating to the skin: more than 40% of acne bacteria are insensitive to oral antibiotics and therapy with oral isotretinoin (Accutane[™]), which is also associated with possible severe side effects and a high cost.

Sun exposure is known to be beneficial in up to 70% of patients with acne. Although solar or artificial UV light has a mild camouflage effect on acne, its comedogenic and photoaging effects prevent its use in acne therapy.¹

It is known that *P. acnes* produce, during their normal life cycle, as a part of their normal metabolism, porphyrines; mainly coproporphyrines.^{2–5} Visible light in the blue range induces a photo-destructive effect on *P. acnes* that may take part in the decrease in acne severity in summer. Blue-violet light (405–420 nm) has been shown to be 10 times more effective than red light (630–670 nm) in triggering excitation of coproporphyrines.² Ashkenazi et al cultured *P. acnes* anaerobically for 72 hours in a liquid medium and illuminated dishes twice (24–48 h interval) for 60 minutes with intense, narrow band violet blue light (405–420 nm, UV-free, 20 mW/cm², total light dose 75 J/cm²). At these conditions, the viability of the culture was decreased by four orders of magnitude compared with the control, untreated bacteria.⁶

A moderate decrease of acne was achieved previously by exposure to light sources producing red light,³ mixed violet and ultraviolet light,^{7,8} or low-intensity fluorescent light.⁹

Shalita et al¹⁰ cultured *P. acnes* from 10 acne patients' foreheads before and after six bi-weekly, 15-minute treatments with UV-free, high-intensity, narrow band blue light (CLA20-1; CureLight Ltd: 405–420 nm, 55 mW/cm², total light dose 50 J/cm²). *P. acnes* cultures were taken before therapy (baseline level) and after the second, fourth and sixth treatments from both the treated and untreated symmetric area. A total of 60% (6/10) of the patients demonstrated a significant reduction (90%) in the levels of *P. acnes* (w1 log, *p*, 0.05). The four patients who showed no significant change in *P. acnes* levels had a low baseline level of *P. acnes* of 1–5 × 10⁴ colonies/cm².^{10,11} Harth et al showed in a preliminary three-center, open study the clinical efficacy of high-intensity, narrow band 420 nm, blue light (ClearLight[®]) on inflammatory acne lesions.¹²

Materials and methods

The ClearLight Therapy System (CureLight Ltd, distributed by Lumenis) is a high-intensity, computerized, UV-free, non-coherent light source intended for the therapy of dermatological disorders such as acne vulgaris by emitting visible light in the violet-blue range with irradiance ranging between 50 and 200 mW/cm².

The system includes a spectral band light source with emission concentrated in the blue band area of 405–420 nm, an optical system for controlling spectra and beam parameters of the light source, a skin cooling system and a built-in computerized digital imaging system for lesion counting and therapy result monitoring.

We examined the clinical effects of high-intensity, narrow band blue light on papulo-pustular acne in a split-face dose–response study, a full-face open trial and a split-face, double-blind controlled study.

Split-face dose–response study

A total of 10 patients and 18 treatment fields were treated by ClearLight. The patients suffered from papulo-pustular acne and were free of any other acne medication for 4 weeks prior to therapy. In each treatment, the face was cleaned and then exposed to narrow band, intense visible blue light (fluence 90 mW/cm²).

The left side of the face was exposed for 8 minutes and the right side of the face was exposed for 12 minutes. Numbers of non-inflammatory and inflammatory lesions were counted before and after eight bi-weekly treatments. Erythema, scale and irritation were monitored.

Full-face—open trial

A total of 13 patients with mild to severe papulo-pustular acne were enrolled in the study: 61% female and 39% male. Patients had a wash-out period of at least 4 weeks from topical or oral anti-acne medications.

Patients were treated twice a week with the ClearLight for a total of 4 weeks. In each treatment the patient was exposed to light for 15 minutes. The number of lesions was counted at all sites at baseline and at the end of 4 weeks

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Results

Split-face dose–response study

There were a total of 18 treatment fields (half-faces). The mean number of 21 inflammatory lesions per patient before therapy decreased to 7.7 after eight treatments (p , 0.001, Student's t -test). Decrease on the left side was by a mean of 65.9%, and on the right side of the face by a mean of 67.6%. No adverse effects to the treatment were noted. In 83% of the treatment areas, there was more than a 50% decrease in inflammatory lesions.

Full-face—open trial

At the end of 4 weeks of therapy, 77% of patients (10/13) responded to therapy with a mean reduction of 59% in inflammatory lesions. At follow-up, 4 weeks after the end of therapy, response rose to 92.3% (12/13), with a mean inflammatory lesions reduction of 81%. No adverse effects were noted in the treated patients. Patients felt no excessive heat or any other type of discomfort during therapy. No therapy-induced erythema or irritation was noticed in any of the assessed patients (Figure 1).

Split-face, double-blinded, self-controlled study (Figure 1)

After eight treatments, 87% (20/23) of the treated sides showed $\geq 20\%$ reduction of inflammatory acne lesions. At the end of therapy, the median reduction of lesions in responders was 60%. Lesion reduction remained steady at 2, 4 and 8 weeks after the end of therapy (59%, 61% and 53% reduction respectively). The inflammatory lesion count at 4 weeks post baseline showed 30% inflammatory median lesion reduction on the untreated sides. No side effects to the treatment were noticed. The

McNemear statistical test verifies effectiveness by looking at patients in which only one side of the face had $\geq 50\%$ reduction in inflammatory lesions. Using McNemear analysis on our data showed highly significant proof of therapy efficacy (treated side⁹ vs untreated side,¹ $p=0.01$) (Figure 2).

Conclusions

Phototherapy for acne is based on the fact that *P. acnes*, the bacteria that populate the sebaceous gland, produce porphyrins as part of its normal metabolism. Exposing these compounds to special wavelengths in the red or, preferably, violet-blue visible light range starts a chemical reaction that produces peroxide, able to kill the bacteria. The reaction takes milliseconds and is confined to the bacteria, thus having no direct effect on the surrounding tissue. *In vitro* research has shown destruction of up to four orders of magnitude after exposing cultures of *P. acnes* to blue visible light. Skin bacteriology research performed at the Department of Dermatology, SUNY Health Science Center in Brooklyn, New York has shown a decrease in one order of magnitude of the bacteria count on all individuals that had *P. acnes* counts greater than 10.⁵

Our data show more than an 80% response to 420 nm acne phototherapy with a significant reduction of 59–67% of inflammatory acne lesions after only eight treatments of 15 minutes. Reduction in lesions was steady at follow-up 2, 4 and 8 weeks after the end of therapy. Prolonged remission is evident in the 8 weeks after the end of therapy. No adverse effects or patient discomfort was noted in any of the patients. Acne phototherapy by high intensity, narrow band 405–420 nm light is proven to be an attractive, fast, effective, non-invasive alternative to current topical and parenteral anti-acne remedies.



Original Research

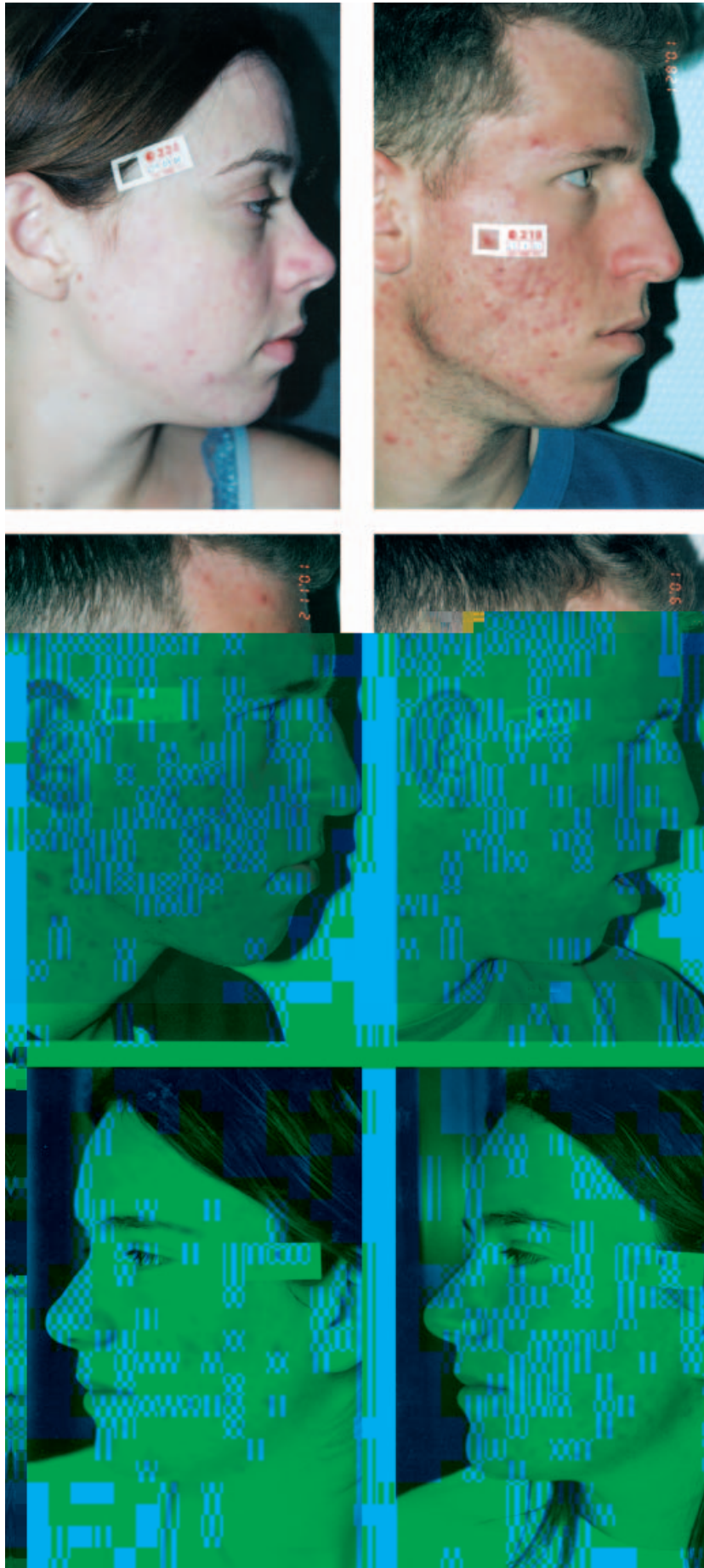




Figure 1
Patient before ClearLight therapy and 2 months after the end of the 4 weeks therapy.

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