

Physical Modalities (Devices) in the Management of Acne



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KEYWORDS

• Acne • Treatment • Devices • Light therapy • Laser therapy • Home Devices

KEY POINTS

- *Propionibacterium acnes* is susceptible to light and laser therapies by targeting porphyrins for the improvement of acne vulgaris.
- Both visible light and laser light are effective treatments for acne.
- Patients desiring devices that can be used at home have several options for light treatment.
- Numerous clinical trials have proven both safety and efficacy for light and laser therapies for acne.

INTRODUCTION

Management of acne vulgaris is an important cornerstone of the dermatologic scope of practice. Traditional physical modalities, such as comedone extraction and solidified carbon dioxide slush, are effective in treating acne vulgaris. Comedone extraction physically removes cellular debris from the follicle, and can improve the efficacy of topical comedolytic therapy. Slush therapy, although not used routinely today, is an effective treatment of acne vulgaris.¹ Laser and light therapies and other modalities are effective treatment options for both papular, pustular, and comedonal acne. These therapies also show promise in areas where topical therapies were lacking efficacy, as in severe acne. Local side effects and adverse events are rare, and systemic side effects are absent. This paper reviews the physical properties of light and laser therapies and other available for the treatment of acne, as well as currently published clinical trials to date.

VISIBLE LIGHT PHOTOTHERAPY *Blue Light*

The target of light therapy for acne vulgaris relies partly on the characteristics of *Propionibacterium acnes*, in that porphyrins produced by the bacteria absorb light in the visible spectrum. The most abundant of these is coproporphyrin III, which has peak absorption at 415 nm, and the singlet oxygen species produced by photoexcitation can eliminate *P acnes* bacteria. High-intensity blue light devices, with narrow band spectrum of 407 to 420 nm, are available for in office use. In an open-label clinical trial with a blue light device, 30 patients were treated twice weekly for a total of 5 weeks. Improvement was seen after 1 week, and at the end of treatment total acne lesions were reduced by 64%. Blue light is most effective for inflammatory acne lesions, with a reduction of papules and pustules of 69% and 73%, respectively.² Other studies with the high-intensity blue light have demonstrated similar efficacy in the

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reduction of inflammatory acne lesions, and reported improvement rates range from 59% to 76%.^{3,4}

Blue Light and Red Light

Combining blue light, which is effective against *P acnes*, with red light can also significantly improve acne vulgaris. Red light has an antiinflammatory effect by modulating cytokine response, and is able to penetrate deeper into the skin than blue light.⁵ Various red and blue light sources have been used successfully to treat acne vulgaris. One published report of fluorescent lamps with 660 nm red light and 415 nm blue light were used by subjects with mild to moderate daily for 12 weeks, and inflammatory lesions were reduced by 75% at the end of the study, as well as a 50% reduction in noninflammatory lesions.⁶ Another study included subjects with severe acne, who improved more significantly than the subjects affected mildly to moderately. A total of 24 subjects were treated with twice weekly alternating sessions of 20 minutes with 415 nm blue light and 20 minutes of 533 nm red light for a total of 8 sessions. After the 4-week treatment period, subjects were followed to 12 weeks and an overall reduction of more than 80% of both inflammatory and noninflammatory lesions.⁷

Intense Pulsed Light

The intense pulsed light (IPL) is a nonlaser device that uses flash lamps and capacitor banks to generate pulsed polychromatic, noncoherent, high-intensity light. The electrical energy is passed through xenon gas to produce light in the emission spectrum of 500 to 1200 nm.^{8,9} Filters can focus the wavelength to the desired spectrum. Several mechanisms of action for IPL devices on acne have been mentioned in the literature. One mechanism involves a photodynamic effect where the absorption of ultraviolet (UV) and visible light by porphyrins in *P acnes* bacteria causes production of highly reactive free radical oxygen that subsequently kill the bacteria. Another mechanism involved is the thermolysis of blood vessels supplying the sebaceous glands. This reduces the production of sebum. Also, a photosensitizer can be applied to the skin that then accumulates in sebaceous glands, and after activated by light, can destroy the sebaceous glands.⁸ Studies have shown that IPL causes an upregulation of the transforming growth factor- β 1/Smad3 signaling pathway in patients with inflammatory acne.¹⁰ ClearTouch (Radiance, Inc, Orabgeburg, NY) was the first IPL system reported to be useful in the treatment of acne vulgaris. There are a few

clinical studies on IPL devices in the treatment of acne, but they are difficult to compare because they used different devices, filters, and energy parameters. Adverse effects of IPL include pain, swelling, erythema, blistering, and crusting.⁹

Elman and colleagues¹¹ completed a study on 19 patients with mild to moderate acne who underwent biweekly treatments of IPL for 4 weeks. Each pulse used an average energy density of 3.5 J/cm², a pulse width of 35 ms, and a wavelength between 430 and 1100 nm. After the eighth treatment, noninflammatory lesions cleared 63% and inflammatory lesions cleared 50%. Acne clearance for noninflammatory and inflammatory lesions was 79% and 74%, respectively, 1 month after the last treatment and had further improvement in acne clearance at 2 months. In 2010, Kawana and colleagues¹² performed a study on 25 Japanese patients, mainly of skin phototypes III or IV, with moderate to severe acne. They were treated with IPL 5 times at wavelengths of 400 to 700 nm and 870 to 1200 nm. After the first exposure, numbers of noninflammatory and inflammatory acne lesions decreased to 36.6% and 43.0%, respectively, of their pretreatment values. After 5 treatments, they decreased to 12.9% and 11.7%, respectively, of their pretreatment values. Transient erythema with or without burning/stinging was noted in 80% of the subjects.

LASER LIGHT SOURCES

Pulsed Dye Laser

The pulsed dye laser (PDL) emits coherent yellow light in the 585 to 595 nm range.⁸ Pulse durations and energy differs for different PDL devices and settings differed for different clinical studies but short pulse duration PDL may be ideal for treating acne vulgaris, as reported using the Nlight (EU-Photonics, Swansea, Wales, UK) with a 350 μ s pulse.¹³ PDL preferentially targets oxyhemoglobin resulting in selective photothermolysis of dilated blood vessels and causes cutaneous immunologic activation.¹⁴ For this reason, it is particularly useful in treating inflammatory acne lesions. It is also known to stimulate dermal remodeling and collagen production, which can help to treat acne scarring.¹⁵ PDL was originally thought to decrease *P acnes* and sebaceous gland activity; however, a study by Seaton and colleagues¹⁶ showed that this was not the case. Instead, PDL is thought to work because of an increase in transforming growth factor- β , a potent stimulator of neocollagenesis and potent inhibitor of inflammation. Transforming growth factor- β was expressed more after PDL treatments than in IPL treatments, most likely because it has a greater photothermal

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