

Treatment of Acne Using the Palomar LuxV™ Handpiece

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Background

Acne vulgaris is a disorder of sebaceous follicles that has multiple factors contributing to its onset. It is associated with an increase in sebaceous gland activity, insufficient shedding of cellular debris plugging the gland's duct and follicle, and proliferation in this oil-rich medium of the *bacterium Propionibacterium acnes* (*P. Acnes*). The excessive accumulation of sebum and bacteria in the pilosebaceous unit leads to formation of pustules, inflammatory papules and cysts. Severe acne may leave permanent scarring.

A variety of drugs are used in the treatment of acne and they target the various factors involved in its pathogenesis. Retinoids effectively increase the shedding of debris from the pilosebaceous ducts by decreasing the proliferation and differentiation of epidermal cells and they also inhibit sebaceous gland activity. They are the most effective drugs to treat acne (i.e., Accutane) but their use is associated with severe side effects (night vision impairment, cracked lips, bone aches, reversible hair loss and, most dangerously, severe teratogenic effects on the fetus if pregnancy occurs while taking this drug).

Antibiotics inhibit *P. acnes* bacteria, and are the mainstay of therapy in combination with topical retinoids and peroxide compounds. The majority of teenagers, and about 30% of adult women suffer from acne. In women, the problem is particularly frustrating because Accutane cannot be used during childbearing years, and antibiotics have frequent side effects.

Sun exposure is known to have a beneficial effect on patients with acne. Visible light in blue range, and to a lesser extent in the red range, is effective in treating *acne vulgaris* through a mechanism similar to that of photodynamic therapy. *P. acnes* produces a large amount of endogenous porphyrins, and when exposed to light these porphyrins release singlet oxygen that is effective in killing bacteria and reducing the severity of acne. There is substantial

evidence that blue light in the 400-420-nm range is capable of improving acne for at least one month after treatment.

In the case of inflammatory acne in addition to porphyrins, there is another chromophore present in large concentration within the lesions: hemoglobin. Inflamed lesions contain a relatively large volume of blood around them that can be selectively targeted for destruction with the right wavelength.

Wavelengths in the 400-600-nm range are highly absorbed by blood: shorter blue-green wavelengths with shallow penetration are absorbed superficially and yellow-orange wavelengths with intermediate depth of penetration are absorbed more deeply. Light in the infrared 800-1400-nm wavelength range penetrates deep into the skin and provides additional blood absorption at deeper levels.

A device that provides light in 400-700-nm and 800-1200-nm ranges will allow one to utilize both mechanisms of action for treatment of acne: to eradicate acne bacteria and damage obstructed and hyperactive sebaceous glands through heating blood vessels around them.

The Palomar LuxV™ handpiece (used with the Palomar MediLux™ and EsteLux™ Pulsed Light Systems) emitting in the 400-700-nm range will be capable of providing visible light therapy for acne. Blue light in the 400-420-nm range is strongly absorbed by porphyrins (the Soret band), and is known to be effective even at fluences of 4 J/cm². However, blue light poorly penetrates to the depth of 1 mm into the dermis where *P. acnes bacteria* is known to concentrate. Porphyrins also have absorption bands in the green and yellow wavelengths and these wavelengths are present in the LuxV handpiece spectral output. Therefore, treatment with this handpiece may not only maximize absorption at the various specific absorption bands, but also facilitate greater depth of penetration of the light to deeper levels in the dermis.

Treatment Objectives

A practical and effective light treatment for acne in the presence of pharmaceutical and device-based treatments must meet the following criteria: it must be comfortable and tolerable without use of topical anesthetics, it must be quick (15-20 minutes per session is ideal), and the number of sessions should not exceed three treatments. The treatment is considered successful when the patient exhibits at least 20% improvement in the number of lesions three weeks after treatment, and at least one grade improvement on the severity grading scale.

LuxV Handpiece

The LuxV handpiece is currently cleared by the FDA for the treatment of pigmented lesions, though it operates in the spectral range and delivers fluence suitable for treatment of acne vulgaris. It emits wavelengths in the 400-700 and 870-1200-nm ranges, with a spot size of 16 x 46 mm and a fluence range of up to 20 J/cm². Pulse durations of 10 ms, 20 ms, 40 ms, 60 ms, and 100 ms are user selectable, and the light pulses are generated at a pulse frequency range of 0.5 - 1 Hz.

Treatment Protocol and Preliminary Results

Seventeen patients (males and females, 15-46 years old) with Fitzpatrick skin type I-III were enrolled in the LuxV study. All of them suffered from facial refractory acne for a number of years and had used conventional topical and/or oral medication with unsatisfactory or mixed results. Even those who responded to the medication developed acne again when taken off the medication.

One patient was treated with 13 J/cm² and 20 msec pulse duration; four patients were treated at 11 J/cm² with pulse duration 60 msec, and the rest were treated with 12 J/cm² at 40 msec. These treatments involved 2 to 4 passes.

Five patients with comedonal acne treated with 12 J/cm² @ 40 msec in 4 passes developed a rather severe inflammatory Retin-A type flare. A flare was severe enough in one patient to prompt withdrawal from the study.

In the subset of patients with extensive comedonal acne, use of 40 msec pulse duration may be too short and 4 passes is too many. There is significant, very likely, follicular irritation and inflammatory damage to sebaceous glands that results in quite remarkable cycling of the acne lesions, similar to Retin-A flare, with transformation of open and closed comedones into pustules.

Two of the patients were treated with 2 and 3 passes at 11 J/cm² @ 60 msec pulse duration. Both did well. It appears that longer pulse durations create gradual reduction in the comedones count without Retin-A-like flare.

Five of 17 patients developed significant Retin-A-like flare-up of acne, which I believe is related to 40 msec pulse duration and multiple passes. Some patients who were treated with 40 msec pulse duration, however, have gradually improved.

Conclusions

Treatment of acne with the LuxV is a promising alternative to current topical and oral anti-acne remedies. There is very strong indication that patients should be treated at two week intervals for 2-4 sessions. Most patients have ended up needing a few treatments during the three-month period, and it appears that it is better to “stay ahead” of the acne, and gently push therapy to clearing rather than waiting for increased acne activity as measured by increased comedone count.

Longer pulse durations, more frequent treatments at shorter intervals, and fewer passes appear to be more beneficial. This protocol will lead to fewer Retin-A-like flare-ups, happier patients and fewer withdrawals from the study.

Use of 60 or 100 msec (both 11J/cm²) pulse duration and two-week interval for a total of 3 treatments is a promising protocol. Conversely, adult females with inflammatory nodular acne without comedones may do better with shorter pulse durations and more passes, e.g., 40 msec (12 J/cm²) with 4 passes.