

## Overview of Acne, Current Therapies, and a Promising New Laser Alternative

Acne is a significant, troubling skin condition representing the single most common reason behind office visits to the dermatologist.<sup>1</sup> Acne affects 80% of the human population with almost no person passing through adolescence without experiencing some form of a blemish or pimple.<sup>2</sup> While some physicians see the disease as merely a cosmetic condition, acne is a disease that can alter a person's physical and psychological life. Most individuals develop acne during their adolescent years, a critical time when self-image and confidence are being formulated. Acne can devastate one's self-confidence, leading to isolation and even depression.

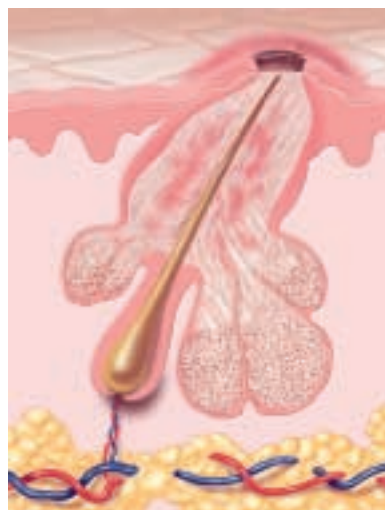
Unfortunately, acne often goes untreated, without even a referral to the local dermatologist. Left untreated, acne can be quite painful and ultimately cause extensive skin damage, resulting in debilitating scar formations.

### About Acne

Acne is an inflammatory skin condition affecting the sebaceous follicles<sup>3</sup> - follicles containing oil-producing sebaceous glands. Each follicle contains a small, vellus hair and a sebaceous gland (see Figure 1). Acne is most common on the face, neck, shoulders, upper back, and chest where there is a high concentration of sebaceous follicles. Symptoms of acne include blackheads, whiteheads, red spots, nodules, and cysts.



**Figure 1- Normal Sebaceous Follicle**  
(note larger glandular lobes and small hair)



**Figure 2- Acne in Sebaceous Follicle**

## Causes of Acne

Acne is clearly linked to natural hormonal increases during puberty. These hormonal increases are believed to cause an increase in the size and sebum output of the sebaceous glands in the follicles. As the skin sheds dead cells, a process called keratinization occurs, blocking the opening of the follicle. As oil production increases, the pore becomes plugged. Bacteria (*Propionibacterium acnes* – *P.acnes*) thrive on the sebum in the plugged follicle and multiply (See Figure 2). This condition makes itself manifest in the formation of a small pimple. If the pore stays open, it leads to the formation of a blackhead. If the pore closes, a whitehead forms. As the *P.acnes* multiply, the follicle can rupture, leading to severe inflammation and the formation of deep cysts.

## Treatment Options

Although many therapies exist for the treatment and control of acne, none are curative. Cessation of most currently available treatments typically leads to a reintroduction of inflammatory lesions. Frequently, patients will use multiple therapies to determine which treatment provides the best individual result. However, many patients fail to respond to existing therapies. Further, some patients experience troubling side effects, such as drying of the skin, a condition often preventing patients from continuing treatment.

Acne can be treated either topically or systemically. Topical applications include benzoyl peroxide, antibiotic lotions, retinoids and salicylic acid. Topicals attempt to dry the skin, reduce bacteria formation or normalize the keratinization process. Systemic treatments, for acne include antibiotics, hormone treatments, and Isotretinoin, which have more significant effects on the skin.

Benzoyl peroxide is available over the counter and is the first therapeutic choice for mild cases of acne. While benzoyl peroxide destroys bacteria (*P.acnes*) trapped in the follicles, it has no effect on sebum production or the keratinization process. Further, continued treatment may irritate and dry out the skin. Benzoyl peroxide has a temporary effect on the skin; and if treatment is halted, acne lesions may reappear.

Antibiotic lotions, available by prescription, work by clearing the skin of *P.acnes* and slowing further proliferation of bacteria. However, these topical lotions do not penetrate to reach bacteria deep

within the follicles. Further, it is evident that newer strains of *P.acnes* are increasingly resistant to antibiotic therapies.<sup>6</sup> Oral antibiotic tablets are prescribed to treat moderate to severe acne. Finally, some systemic antibiotics are known to reduce the effectiveness of oral contraceptives, increasing the risk of pregnancy during treatment.

Retin-A or “retinoids” are available in creams, gels, and lotions. Retinoids normalize the keratinization process. By normalizing the skin’s growing and shedding process, pores are less likely to become plugged. Retinoids are known to dry and irritate the skin.

Systemic treatments are usually reserved for moderate to severe cases of acne. Hormone treatments like oral contraceptives are marketed directly to patients with the added benefit of improving one’s appearance by reducing acne lesions. Oral contraceptives are female hormones designed to counteract the effect of male hormones (androgens) on acne. This can reduce the size and sebum output of the sebaceous gland.

Isotretinoin (Accutane) is a powerful and effective anti-acne therapy used to control severe cases of acne. Isotretinoin works by altering the structure of the sebaceous gland, reducing its sebum output and reducing the bacteria generated from this gland. Although effective for treating acne, Isotretinoin can have dramatic side effects; its use is limited to the most severe cases of acne. Further, Isotretinoin therapy is costly and directly linked to emotional depression and severe birth defects, if used during pregnancy.<sup>5</sup>

## Light-Based Treatments

The use of “blue” light on the skin to reduce bacteria counts is an emerging therapy. Repetitive exposure of the surface bacteria to 407-420 nm blue light can destroy the *P.acnes*. Destruction of the *P.acnes* can reduce both the number and proliferation of inflammatory lesions. However, there is no evidence to suggest that exposure to this type of light affects the structure or function of the sebaceous gland.

Blue light treatment protocols require weekly treatments to destroy *P.acnes*. A typical treatment protocol requires biweekly individual treatments over as many as eight weeks. Each treatment visit is expected to require 15 minutes per affected area as these devices typically treat a 30 x 30 cm<sup>2</sup> area per session. Multiple treatments are required as the penetration of 407-420 nm into skin is limited and

may only reach bacteria in the upper infundibulum.<sup>7</sup> However, bacteria within the sebaceous follicles frequently resides beyond a 1 mm depth, beyond the penetration of these types of light-based treatments. This could explain the published reports of a lack of response in 20% of patients and the need for multiple biweekly treatment sessions.<sup>7</sup>

Therapeutic challenges include patient compliance as well as the duration of remission. Routine clinical experience indicates that adolescent patient compliance is always a consideration. With the “blue” light technique noted above, a typical treatment regimen requires 16 to 18 visits over the course of eight weeks. The consequences of patient noncompliance

or an incomplete treatment regimen are a likely return to *P.acnes* proliferation. Finally, since only existing bacteria are destroyed, recolonization of new bacteria is likely. There is no evidence that blue light therapy has more than a temporary, short-term effect on acne lesions.

### Laser Treatment - A New Approach to Acne

Lasers might be new to acne treatment but they have been used to safely treat various conditions in the skin for many years. As discussed earlier, three factors are required for the formation of acne: an increase in sebum production, a blockage of the



Figure 3- Acne in Sebaceous Gland



Figure 4- Dynamic Cooling of Epidermis



Figure 5- 1450 nm Laser Irradiates the Skin



Figure 6- Thermal Injury to Sebaceous Gland

infundibulum, or an opening of the follicle and the subsequent proliferation of bacteria.

A new device that is currently being developed for the treatment and control of acne is laser based. The laser is designed to target acne's root cause, the overactive function of the sebaceous gland. In order to have the most significant impact on acne, the sebaceous gland and infundibulum are being targeted using this new diode laser. A wavelength of 1450 nm was chosen to maximize the thermal effect on both the upper dermis and the sebaceous gland. This wavelength is highly absorbed by water, the dominant chromophore in both the dermis and the sebaceous gland. As a result of its strong absorption by water, penetration depth is limited to the upper, papillary dermis of the skin.

Investigational studies have been performed to evaluate the safety and efficacy in using the 1450 nm diode for the treatment of acne of the back.<sup>8</sup> The lead clinical investigator, Dr. E. Victor Ross, explains, "This wavelength is capable of producing a thermal injury to a depth of approximately 400-500 microns, right where we want it (see figure 5). The thermal injury profile of 1450 nm wavelength matches the anatomic depth of the sebaceous gland that we are trying to injure."

As the laser energy is transmitted, it is absorbed by water in and around the targeted gland, and heat is generated (see figure 6). The epidermis is cooled and protected by a burst of cryogen spray before, during, and post-laser exposure.

Dr. Ross explains further, "Initial histological evidence shown below suggests that the 1450 nm wavelength heats structures around and within the sebaceous glands. It has been noted in this study that the sebaceous glands seem to be hypersensitive to heat exposure. This was observed in an earlier study where sebaceous glands in the histological sections were damaged, even when there was no obvious evidence of collagen denaturation or thermal damage to other adjacent dermal structures. What is unique about this study is that we are able to show thermal injury that seems to have altered the structure of the sebaceous gland. The thermal injury seems to have its greatest effect on the gland and the infundibulum."

Dr. Ross comments, "In our continued clinical work, we are hoping to demonstrate the mechanism of action more clearly. We are embarking on research to further investigate that this thermal injury impairs excessive glandular function and reduces sebum output to lower, more normal levels. This could help us explain the significant reduction in lesion counts and acne severity seen in our study."

Figures 7 and 8 demonstrate a clinical example of patients treated with the Smoothbeam 1450 nm laser for acne on the back. One area of the back was treated with the laser, with the control site receiving cryogen spray only.<sup>8</sup> Figure 7 demonstrates the treated site 3 weeks after second treatment – note: lesion clearance. Figure 8 demonstrates the control site (untreated) 3 weeks after second treatment – note: presence of acne lesions. Study patients received four treatments with follow up photos taken at 6 weeks, 12 weeks and again at 24 weeks.

## Conclusion

Initial experience suggests that treatment of acne using the Smoothbeam represents a major advance in treatment for one of the most common dermatological conditions. The 1450 nm diode laser is a promising new treatment modality for acne on the back, with a minimal side-effect profile.

## References

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**Figure 7- Three weeks after the second treatment. Clearance of lesions is seen.**



**Figure 8- Control area at three weeks after the second treatment. Lesions are still present.**

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