1726 nm Lasers for the Treatment of Acne Vulgaris

Julie Bittar, MD[1]; Perry Hooper, MD[2]; Jeffrey S. Dover, MD, FRCPC[2,3]

[1]Rush University Medical Center, Department of Dermatology, Chicago, IL, USA

[2]SkinCare Physicians, Chestnut Hill, MA, USA

[3]Yale University School of Medicine, Department of Dermatology, New Haven, CT, USA

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ABSTRACT

The treatment of acne vulgaris traditionally consists of a combination of topical and oral medications. The use of lasers to treat this condition has been an area of increasing research, and several types have previously been used in the treatment of acne. New 1726 nm lasers specifically target the sebaceous gland, which is known to be pivotal in acne pathophysiology. This laser wavelength demonstrates substantial potential as a safe and effective therapeutic option for moderate to severe acne without the risks of systemic therapy. This paper reviews the 1726 nm lasers for acne vulgaris.

Keywords: 1726-nm laser, acne laser, laser acne treatment, laser treatment, contact cooling, forced-air cooling, acne vulgaris, acne scarring, acne severity, acne skin types, acne treatment, sebaceous glands, selective photothermolysis

Introduction

Acne vulgaris is a chronic inflammatory disease of the pilosebaceous unit. The pathophysiology of acne formation is multifactorial. Elevation of androgen levels, associated with puberty, lead to increased production of sebum in the pilosebaceous unit. This is accompanied by proliferation of *Cutibacterium acnes (C. acnes)* and resultant inflammation. While several factors have been associated with acne formation and progression, the sebaceous gland has long been known to play an essential role in the disease.

Various treatments are typically used in the management of acne vulgaris. Standard treatments for moderate to severe acne use a combination of topical and systemic medications, light-based therapy, lasers, photodynamic therapy, radiofrequency devices, and other physical modalities, but supporting studies of their effectiveness have been limited.[1] Use of lasers is an area of increasing research as several devices have shown promise in the reduction of acne lesions and improvement of the overall appearance of skin (Table 1).[2] Very recently, two new 1726 nm lasers which target sebaceous glands were approved by the US FDA for the treatment of acne.

Laser	Wavelength (nm)	Target chromophore
Neodymium-doped yttrium aluminum garnet (Nd:YAG)	1064	Hemoglobin, melanin
Pulsed dye laser	585-595	Hemoglobin
Diode	1450	Water
Alexandrite	755	Deoxyhemoglobin, melanin
Potassium titanyl phosphate (KTP)	532	Hemoglobin, melanin

Table 1: Lasers for acne vulgaris.

The efficacy of these devices is based on the theory of selective photothermolysis.[3] Selective photothermolysis is the selective and localized injury of microscopic tissue targets through a combination of selective light absorption and a pulse duration less than or equal to the thermal relaxation time (TRT) of a target chromophore. Simply stated, different structures preferentially absorb specific wavelengths of light. By using these "absorption peaks", specific chromophores (e.g., sebaceous gland) can be targeted while sparing other structures. The result is an increased efficacy and safety profile. In 2012, Sakomoto et al. studied the absorption spectrum of sebum to determine feasibility of selective photothermolysis of sebaceous glands.[2] They found that at 1726 nm, *in vivo* sebum has 1.2x the optical absorption of water. Further, laser-induced heating was approximately 1.5x higher in sebaceous glands than water at 1710 nm and 1720 nm. Thermal imaging showed focal heating near sebaceous follicles. Histologic evaluation demonstrated selective thermal damage to sebaceous glands while the epidermis remained undamaged.[4]

Supporting Data

1726 nm lasers have been tested in all skin types and because of low absorption in pigment these systems have been found to be safe in all skin types. The two FDA approved 1726 nm devices are the AviClear Laser System (Cutera, Inc.) and Accure Laser System (Accure Acne Inc.) (Table 2).

The AviClear device is a 1726 nm laser that treats acne via selective photothermolysis of the sebaceous gland. It is FDA approved to treat mild to severe inflammatory acne in all skin types. AviClear uses a 3 mm spot size and contact cooling to prevent damage to other surrounding structures. The target endpoint of this laser is fluence. The duration of each treatment is approximately 30 minutes. In a study by Scopelliti et al., the authors tested the 1726 nm AviClear device at a fluence (F_o) of 20.5 J/cm^2 on human facial skin around the ear and then biopsied the site 5 days post treatment. Histology showed total necrosis of the sebaceous gland with complete sparing of the epidermis and follicular epithelium.

Early evidence for this device is promising. Goldberg et al. studied the AviClear device in 17 patients and performed three treatments,

	AviClear	Accure
Type of laser	Diode	Fiber
Wavelength (nm)	1726 nm	1726 nm
FDA approved indication	Mild to severe acne vulgaris	Mild to severe acne vulgaris
Skin cooling	Contact cooling with cold sapphire plate (0°C to 5°C)	Forced air cooling
Endpoint	Fluence, differs per pulse (maximum fluence for single pulse mode: 30 J/cm^2; double pulse mode: 20 J/cm^2)	Peak epidermal temperature (PET) of 40.0°C - 46.0°C
Spot size	3.0 mm (single spot); 10.0 mm (7 spot hexagonal array)	4.7 mm
Treatment depth	200-750 microns	450-1750 microns

Table 2: Comparison of AviClear versus Accure acne laser systems.

spaced up to 7 weeks apart. All patients tolerated the treatment without anesthetic (discomfort score of 4.9± 1.5 out of 10). Patients had statistically significant reductions in acne with a 52% reduction in inflammatory lesion count within 1 month of treatment and a 97% reduction 24 months after the last treatment.[5] A larger, non-randomized, open label study by Alexiades et al. enrolled 104 patients with moderate to severe acne, allowed for a 30-day washout of all acne products, and then performed 3 monthly treatments utilizing the 1726 nm AviClear laser. Three dermatologists assessed patients at baseline and post-treatment at 4-, 12-, and 26-week timepoints utilizing Investigator's Global Assessment (IGA) scale. An IGA score of 0 correlates to clear skin, IGA 1 is almost clear, IGA 2 is mild, IGA 3 is moderate, and IGA 4 indicates severe acne. The authors found that at 3 months, 87% of patients achieved a score of IGA 1+, 47% achieved IGA 2+, and 36% were clear or almost clear. Additionally, at the 12 month follow up, 93% of patients had achieved IGA 1+, 79% with IGA2+, and 68% were clear/almost clear.[6] Furthermore, there is no available data on the differences in outcomes for facial versus truncal acne outcomes with this device, however, AviClear is currently developing a truncal handpiece.

The Accure device is another FDA approved 1726 nm laser that treats mild to severe inflammatory acne vulgaris via selective photothermolysis of the sebaceous gland. This device employs an infrared camera for real-time, continuous, epidermal temperature monitoring. This allows for a peak epidermal temperature (PET) of 40°C-46°C depending on body site to serve as the objective clinical endpoint. The PET correlates with selective sebaceous gland damage. The epidermis is protected via highly controlled, forced air cooling. These therapeutic and safety measures also allow use in all skin types. There are two "modes" on the device, "Standard Mode" and "Boost Mode". The primary difference in these two modes lies in the anesthetic used. The Standard Mode utilizes injectable anesthesia (lidocaine/1% epinephrine/saline/sodium bicarbonate mixture) while the Boost Mode uses a topical anesthetic. The Boost Mode also utilizes a unique proprietary pulsing method. A single-use patient treatment kit contains a one-time-use device tip as well as template grids which guide the spacing of injection points. Using a marker, the markings are spaced 13 mm apart for the first treatment then 11.5 mm apart for the following treatments. The primary investigators found that this spacing interval provided safe and optimal results.[7] The duration of each treatment is approximately 45 minutes.

To date, 10 institutional review board-approved clinical trials with more than 180 patients with mild to severe acne have been treated. It should be noted that all data described below is preliminary and unpublished.

In a previously presented study of 12 patients treated using the standard mode by Tanghetti et al., there was an 80% reduction in acne lesions noted 12 weeks after a fourth monthly treatment.[8] An additional 30 patients treated in Standard Mode were enrolled in Accure's facial acne trial. In this trial, there was a 100% responder rate, defined as a 50% reduction in active lesions, noted at 4, 8, 12, and 24-weeks after four monthly treatments post-treatment for patients with more than 5 acne lesions. There was an 82% average lesion reduction at 12 weeks following four monthly treatments and a 90% decrease at 12 months. The most commonly reported side effects with the Accure laser are post-treatment erythema, edema, and acne flares. Dryness and crusting are also possible, but rare.[9]

Initial data from Accure's ongoing Boost Mode clinical trials showed a median reduction of inflammatory acne lesion counts of 79%, 68%, 75%, and 90% at 12, 26, 39, and 52 weeks, respectively, after four monthly treatments. However, only 17 of 35 patients were available for long-term data collection. The authors also showed a 100%, 83%, 80% and 88% responder rate, defined as a 50% reduction or greater in acne lesions, at 12, 26, 39, and 52 weeks.

Additionally, there is no available data for the difference in outcomes for facial versus truncal acne with the Accure device. This device currently uses the same single-use patient tip for all treatment areas and different target PET settings depending on body site.

Conclusion

1726 nm lasers appear to be effective and well tolerated therapeutic options for the treatment of mild to severe inflammatory acne vulgaris while eliminating the risks of systemic agents. The results from studies demonstrate significant reduction of inflammatory lesion count and do not report on comedonal lesions. The effects of both of these devices on comedonal acne still need to be investigated. As these devices are used in non-study settings, more will be learned about their effectiveness and how to best incorporate them into our acne therapeutic armamentarium. To date, no direct clinical comparisons have been made between the AviClear and Accure lasers.

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