

577-nm High-Power Optically Pumped Semiconductor Laser is Safe and Effective in The Treatment of Inflammatory Acne: A Prospective, Single-Center, Split-Face Comparative Study

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Research

Keywords: 577 nm diode laser, acne, vascular laser

Posted Date: January 11th, 2021

DOI: <https://doi.org/10.21203/rs.3.rs-141449/v1>

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Abstract

Objective: This study aimed to appraise the efficacy of a 577 nm high-power optically pumped semiconductor laser (HOPSL) for the treatment of inflammatory acne.

Methods: The study included 50 patients with acne vulgaris (inflammatory type), 14 men, and 36 females; patient ages ranged from 16 to 35 years. The left side of the face was treated with a single pass of a 577 nm high-power optically pumped semiconductor laser every 2 weeks for 3 sessions. Patients were examined prior to the first session and 4 weeks after the last session (Investigator's Global Assessment of acne severity, IGA; single lesion count).

Results: At baseline, no statistically significant difference in the severity of inflammatory acne lesions between both sides was observed. One month after the final session, a significant improvement (IGA reduction of >50 percent) of the over-all severity of the acne was observed in 49 patients (98 percent) on laser-treated side versus 41 (82 percent) the control side of the face ($P < .05$). Accordingly, we found a significant reduction in the mean percentage of inflammatory papules, pustules, and nodules (79.33 vs 56.92, 78.04 vs 43.33, 64.85 vs 21.93 percent, respectively) ($P < 0.05$). Side effects in the form of erythema and irritation during sessions were transient and tolerated by the patients.

Conclusion: The 577 nm high-power optically pumped semiconductor laser is effective and safe for the treatment of inflammatory lesions (papules, pustules, and nodules) in acne patients.

Running title: 577 nm high-power optically pumped semiconductor laser (HOPSL) for the treatment of inflammatory acne

Introduction

Acne vulgaris is a common chronic inflammatory disease affecting the sebaceous glands. Acne can be classified into non-inflammatory type (comedones), or inflammatory type (papules, pustules, and nodules)¹. Acne commonly affects adolescents and young adults, can cause scarring, and can result in low self-esteem and affect mental health².

The pathogenesis of acne is multi-factorial and includes an overproduction of sebum due to androgen stimulation, follicular hyper keratinization, a colonization with *Cutibacterium acnes*, and inflammation³.

Available treatment options for acne include mainly topical and oral drugs. One of the problems of the topical treatment is that it requires frequent application (compliance), while the use of oral medications may be associated with more severe side effects⁴.

Different types of lasers have been used to treat acne vulgaris in the past years. Of these, vascular lasers are reported to improve inflammatory acne lesions safely and efficiently⁵. Lasers are proposed to decrease *Cutibacterium acnes* and to reduce the pilosebaceous unit size and function⁶. Here, we aimed

to assess the efficacy of a novel 577 nm high-power optically pumped semiconductor laser (HOPSL) in the treatment of inflammatory type acne.

Patients And Methods

Fifty patients with inflammatory type acne participate in this single-center, prospective, half-side controlled, split-face study after being approved by the Ethics Committee of Al-Azhar university hospital.

Exclusion criteria non-inflammatory type acne, pregnant or lactating females, active herpes simplex infections, keloids or hypertrophic scars, photosensitivity, immuno-compromised patients, and patients who had received systemic or topical antibiotics in the last month or oral isotretinoin in the last 6 months.

The mean age of the patients was 21.62 and the mean duration of acne was 3.5 years (range: 1–7 years); 14 patients were males and 36 were females; Fitzpatrick skin types included types III (14, 28 percent), types IV (32, 64 percent) and types V (4, 8 percent). A total of 50 patients (14 males and 36 females) with inflammatory acne, with a mean age of the patients was 21.62 (range: 16–29 years) and the mean duration of acne was 3.5 (range: 1–7 years) were included in the study. According to Fitzpatrick skin type, patients were classified into 14 (28 percent) patients were type III and 32 (64 percent) patients were type IV and 4 (8 percent) patients were type V.

The left side of the face was treated with a single pass of a novel 577 nm high-power optically pumped semiconductor laser (HOPSL) (QuadroStarPRO, Asclepion Laser Technologies, Jena, Germany) for 3 sessions at 2 weeks intervals. Fluence was started with 17J/cm² in the first session and was increased by 2 J/cm² in every additional session; pulse duration ranged from 28–32 ms according to the skin photo type; the laser was applied in scan-modus with a coverage of 80 percent. Patients were advised to avoid sun exposure and use topical sunprotection with SPF > 30. No additional acne-specific treatments were performed during the study period.

Patients were evaluated at baseline and 4 weeks after the final laser-session by clinical examination and standardized photography (Canon PowerShot A3400 IS 16MP digital camera). Acne severity was quantified according to the Investigator's Global Assessment of acne severity (IGA) score and by single lesions count (inflammatory papules, pustules, and nodules).

Results

Prior to treatment no statistically significant difference in acne severity was noted between laser and non-laser treated sides. After treatment, significant improvement (IGA reduction > 50 percent) was observed in 49 (98 percent) on laser-treated side versus 41 (82 percent) versus the non-laser treated side ($P < .05$) (Fig. 1; Table 1). At the final visit, there was a significant reduction in the mean percentage of inflammatory acne lesions at the laser-treated side vs. the non-laser treated side ($P < .05$). In detail, we found a relative reduction of inflammatory papules (79.33 vs 56.92 percent), pustules (78.04 vs 43.33 percent), and nodules (64.85 vs 21.93 percent) for the laser-treated side vs. the non-laser treated side

(Fig. 1; Table 2). Reported side effects were mild and included transient erythema and irritation during sessions. Side effects were well tolerated by the patients.

Discussion

Acne vulgaris is common skin diseases, which varies in severity between patients and is frequently affects the psychological state of affected patients⁷. Acne can be classified into the inflammatory and the non-inflammatory type. There are several ways to treat acne, including topical formulations and oral medications, as well as light-based treatments. The treatment of choice or combinations thereof depends on disease type and severity, its effect on patients' psychological status, and the presence of contraindications to any line of treatment⁸.

Due to their efficacy and favorable side effects laser- and intense pulsed light (IPL) systems have been well established in the treatment of inflammatory acne^{9,10}. Vascular lasers, including pulsed dye lasers (PDL) are one of the most common type of lasers used in acne treatment^{5,11}. Alexiades-Armenakas reported that 19 patients with inflammatory acne vulgaris achieved excellent response after 595 nm PDL therapy¹². Whereas an additional study showed a significant effect for PDL therapy in acne patients¹³, another split-face study on 40 patients with facial acne treated with non-purpuric PDL did not show significant improvements¹⁴.

Comparable to a 595 nm PDL, a novel 577 nm high-power optically pumped semiconductor laser (HOPSL) (QuadroStarPRO, Asclepion Laser Technologies, Jena, Germany) emits yellow light. HOPSL was shown to effectively treat many skin diseases (vascular and pigmentary)^{15,16,17}; yet, to date no study has assessed its efficacy in inflammatory acne.

In the present study, a single pass of 577 nm HOPSL was applied to one half of the face of patients suffering from inflammatory acne, achieving a significant improvement in the vast majority of the cases (IGA as well as single lesion count). Side effects were mild and well-tolerated.

As compared to other vascular laser- and IPL-systems the following mechanisms of action can be postulated: The 577 nm diode laser exerts a photochemical effect on *Cutibacterium acnes* through absorption of light by porphyrin and release of reactive oxygen (ROS) species thereby reducing the numbers of bacteria. Moreover, the laser generates photothermal effects via heating of the blood vessels and sebaceous glands^{5,18}. Finally, vascular laser treatments have been shown to induce transforming growth factor beta (TGFbeta), suggesting additional anti-inflammatory effects⁸.

In conclusion, our study demonstrates that the 577 nm high-power optically pumped semiconductor laser (HOPSL) is safe and effective in treatment of inflammatory acne vulgaris.

Declarations

Authors' contribution

MEEM, PAG, TKM, EIB, EB and JH wrote parts of the manuscript. MEEM and PAG did the literature research and prepared the data for analysis.

MEEDM, PAG contributed significantly to the discussion on the interpretation of the results. All authors read and approved the final manuscript.

Competing interests

The authors declare that they have no competing interests.

Availability of data and materials

All data and materials can be accessed via MEEM and PAG

Consent for publication

All authors gave consent for the publication

Ethics approval and consent to participate

The study was approved by the local ethical commission.

Conflict of Interest: All authors declare that they have no conflict of interest.

Funding

There was no funding for this investigation.

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Figures



Figure 1

577 nm high-power optically pumped semiconductor laser (HOPSL) is effective in the treatment of inflammatory acne vulgaris: Five representative cases, showing acne severity at baseline (a and c) and four weeks after treating the left side of the face with 3 sessions of 577-nm high-power optically pumped semiconductor laser (d) versus no treatment for the right side of the face (c). Clinical improvements were significantly better on the laser-treated side (d vs. c).