Review

Clinical Application of Laser for Acne Vulgaris: An Update and Critical Review

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Abstract: **Background:** Acne vulgaris is a common chronic inflammatory disorder driven by sebaceous hyperactivity, follicular hyperkeratinization, *Cutibacterium acnes* proliferation, and inflammation. Although topical and systemic agents remain standard therapy, their use is often limited by irritation, antimicrobial resistance, teratogenicity, systemic adverse effects, and poor adherence. These limitations have increased interest in laser and light-based therapies as targeted, nonpharmacologic alternatives or adjuncts capable of addressing multiple pathogenic pathways. **Methods:** This update and critical review used structured evidence mapping of peer-reviewed publications indexed in MEDLINE, PubMed, and Ovid from 2024 to 2026. Eligible studies included randomized controlled trials, split-face trials, cohort studies, case series, systematic reviews, meta-analyses, and expert reviews evaluating lasers, light-based devices, and photodynamic therapy for active acne. Forty-two publications were included and appraised according to Oxford Centre for Evidence-Based Medicine levels to assess efficacy, safety, tolerability, and emerging treatment paradigms. **Results:** Recent evidence shows a transition from broad phototherapy toward mechanism-based energy devices. Sebum-selective 1726 nm lasers demonstrated promising efficacy, acceptable safety across diverse skin phototypes, and potential durability through selective sebaceous gland photothermolysis. Vascular lasers, including 577–589 nm and 585 nm systems, consistently improved inflammatory lesions and post-inflammatory erythema. Various 1064 nm Nd:YAG platforms showed benefit for inflammatory acne, deeper lesions, and early scar prevention. Solid-state dual-wavelength lasers and optimized photodynamic therapy protocols further enhanced lesion reduction, while newer cooling systems and software-assisted temperature monitoring improved procedural precision and reduced pain or pigmentary risk. Evidence from meta-analyses also supported selected combination use with isotretinoin, challenging older safety concerns. **Conclusions:** Laser and light-based therapies are evolving into important adjunctive and, in selected patients, alternative treatments for acne vulgaris. The strongest advances involve sebaceous targeting, vascular modulation, and safer treatment delivery across skin types. However, heterogeneity in parameters, cost, and limited long-term relapse data still restrict universal standardization. Future multicenter trials should define optimal protocols, clarify durability, and refine combination strategies to maximize efficacy, safety, and accessibility for broader adoption across routine dermatologic practice in coming years.

Keywords: acne vulgaris; laser therapy; photochemotherapy; sebaceous glands; sebum; hyperpigmentation

1. Introduction

Acne vulgaris is a ubiquitous, chronic inflammatory disorder of the pilosebaceous unit that affects a significant proportion of the adolescent and adult populations worldwide [1]. The pathogenesis of acne is complex and multifactorial, conventionally attributed to four primary interactive pathways: androgen-mediated stimulation of sebaceous gland hyperplasia and excessive sebum production, abnormal follicular desquamation leading to comedogenesis, colonization and proliferation of *Cutibacterium acnes* within the follicle, and the subsequent release of pro-inflammatory mediators triggering local tissue inflammation [2]. Traditional management strategies encompass a spectrum of topical agents, such as retinoids, benzoyl peroxide, and antibiotics, as well as systemic therapies including oral isotretinoin, hormonal agents, and oral antibiotics [3]. Although these conventional therapies demonstrate established clinical efficacy, their widespread use is frequently compromised by formidable clinical challenges, including localized skin irritation, emerging antimicrobial resistance, and severe systemic adverse effects, most notably the teratogenicity and psychiatric concerns associated with oral isotretinoin [4].

In response to this clinical imperative, the integration of physical therapies, specifically laser and light-based energy devices, has revolutionized the dermatological armamentarium for managing inflammatory and non-inflammatory acne [5]. Early phototherapy targeted the endogenous porphyrins produced by *C. acnes*, utilizing blue and red light to induce oxidative stress and bacterial photoinactivation [6]. However, advancements in selective photothermolysis have catalyzed the development of sophisticated laser systems designed to precisely target the anatomical and physiological substrates of acne pathogenesis without inflicting collateral damage to the surrounding epidermis [7]. The fundamental mechanism underlying modern laser interventions involves the modulation of the sebaceous gland microecosystem, either through direct thermal destruction or temporary functional suppression, alongside the attenuation of the vascular and inflammatory components intrinsic to acne lesions [8]. Vascular lasers, such as the pulsed dye laser (PDL) and potassium titanyl phosphate (KTP) laser, primarily target hemoglobin, effectively reducing erythema, accelerating the resolution of active inflammatory papules, and simultaneously mitigating the risk of post-inflammatory erythema [9].

The contemporary landscape of laser therapy for acne vulgaris is characterized by an increasing diversity of available modalities and a deeper understanding of their optimal clinical applications [10]. Devices such as the 1064 nm neodymium-doped yttrium aluminum garnet (Nd:YAG) laser, both in long-pulsed and Q-switched configurations, have demonstrated profound dermal penetrance, exerting thermal effects that modulate sebaceous gland function and stimulate neocollagenesis, thereby aiding in simultaneous scar prevention [11]. Furthermore, the introduction of novel wavelengths, such as the 1726 nm laser, capitalizes on the specific absorption peak of human sebum, representing a paradigm shift toward targeted, non-pharmacological sebosuppression [12].

Despite these technological strides, the clinical application of laser therapy in acne management requires meticulous consideration of patient-specific variables, most notably skin phototype, to circumvent adverse events such as post-inflammatory hyperpigmentation (PIH) and blistering, particularly in patients with skin of color [13]. The lack of standardized protocols, variations in laser parameters across studies, and inconsistencies in assessing long-term relapse rates continue to pose challenges to the universal adoption of these devices [5]. Furthermore, evaluating the cost-effectiveness and accessibility of laser treatments compared to traditional pharmacotherapy remains a critical component of clinical decision-making. Given the rapid proliferation of new energy-based devices and the continuous publication of clinical trials, there is a distinct need to systematically synthesize the latest evidence to guide dermatologic practice. Therefore, this article provides an update and critical review of the recent literature, focusing on the efficacy, safety, and evolving paradigms of laser therapy for the treatment of acne vulgaris.

2. Methods

To provide a contemporary synthesis of laser applications for acne vulgaris, an evaluation of peer-reviewed literature indexed in MEDLINE, PubMed, and Ovid databases was undertaken, specifically targeting publications from the years 2024 to 2026. The scope of inclusion encompassed randomized controlled trials (RCTs), prospective and retrospective cohort studies, case series, comprehensive systematic reviews, meta-analyses, and expert consensus reports evaluating the utilization of lasers, light-based devices, and photodynamic therapy in treating active acne.

A total of 42 eligible publications were identified and included in this analysis. Each study was rigorously assessed and assigned an evidence level according to the Oxford Centre for Evidence-Based Medicine (CEBM) Levels of Evidence (March 2009) [14].

3. Result

Ren et al. [15] a broad conceptual framework in their narrative review for contemporary phototherapy in acne vulgaris, organizing the literature around three clinically relevant domains: reduction of sebum activity, suppression of inflammation, and prevention or improvement of acne scarring. The paper is valuable because it treats laser therapy not as a single intervention but as a family of modality-specific approaches with distinct biologic targets. It emphasizes tailoring wavelength choice to lesion type and treatment goals, and it places modern sebum-selective systems within the larger evolution of acne care toward mechanism-based procedural therapy rather than purely empirical energy delivery (Level 5).

Jafarzadeh et al. [16] synthesized evidence on vascular lasers for active inflammatory acne and is important because it evaluates a treatment strategy aimed at the inflammatory vascular milieu rather than comedolysis alone in their systematic review. Across the included literature, the authors conclude that vascular devices can shorten lesion persistence, improve papules and pustules, and help address residual erythema that often troubles patients even after inflammation subsides. The review also highlights that outcomes depend on repeated treatments and careful parameter selection. Its main contribution is to position vascular lasers as rational tools for inflammatory phenotypes, although protocol heterogeneity remains a major limitation of the evidence base (Level 1a).

Huerth et al. [17] discusses established and emerging laser treatments across diverse skin types and is especially useful for its emphasis on practical dermatologic decision-making in skin of color in the clinical review. Rather than presenting efficacy in isolation, the paper frames device selection around pigment risk, epidermal protection, and the trade-off between therapeutic intensity and dyschromia. Longer wavelengths, conservative fluence selection, and strong cooling strategies are presented as central safety principles. The article therefore contributes not only a summary of available technologies but also a clinically relevant interpretation of how acne laser therapy must be adapted when treating Fitzpatrick IV-VI patients (Level 5).

Ishii et al. [18] surveys light- and laser-based therapy for acne vulgaris in a way that is directly applicable to office practice in the clinical review. Its value lies in integrating different modalities into a patient-selection framework rather than simply listing wavelengths. The authors discuss when procedural therapy is most relevant, such as medication intolerance, incomplete response to standard care, concern about systemic toxicities, or early scar formation. They also distinguish between modalities that primarily reduce microbial load, those that target inflammation, and those that influence sebaceous activity. In doing so, the article helps define where energy-based therapies fit within contemporary acne algorithms (Level 5).

Pour Mohammad et al. [19] evaluates modern procedural therapies for both inflammatory and non-inflammatory acne, with particular attention to safety, tolerability, and relapse in their systematic review. The paper is valuable because it moves beyond short-term lesion reduction and addresses durability, which is a central issue in energy-based acne management. The synthesis suggests that treatments providing only transient antibacterial or anti-inflammatory effects may not sustain remission as reliably as modalities capable of deeper structural or functional sebaceous gland alteration. The review also underscores that the apparent success of many devices is difficult to compare directly because of heterogeneity in endpoints, follow-up duration, and concomitant therapies (Level 1a).

Xu et al. [20] focuses on the sebaceous gland microenvironment and explains why light- and laser-based therapies may exert effects beyond immediate lesion clearance in their mechanistic review. The article discusses how thermal and photobiologic interventions can alter sebum composition, local microbial ecology, and inflammatory signaling within the pilosebaceous unit. By framing acne treatment around microecosystem modification, the review helps interpret why some modalities show delayed but durable benefit, whereas others provide early but temporary improvement. Although not a clinical trial, the paper contributes meaningful biologic context for understanding differences among wavelengths and supports the concept that sebaceous targeting is central to longer-term disease control (Level 5).

Jean-Pierre et al. [21] surveys emerging laser and light-based therapies in acne and captures the transitional moment when acne lasers moved from adjunctive options toward more targeted, mechanism-driven interventions in their narrative review. The authors emphasize the growing distinction between older broad-spectrum light approaches and newer devices designed to selectively address sebaceous glands, vascular change, or scar risk. The review is helpful because it synthesizes the conceptual shift in the field rather than focusing narrowly on one wavelength. It also underscores that procedural acne therapy should be judged by selectivity, tolerability, and integration with standard care rather than by immediate lesion reduction alone (Level 5).

Jaalouk et al. [22] examined the effect of energy-based devices on sebum in acne vulgaris and is particularly important because it centers on one of acne's core pathogenic drivers in their systematic review. Instead of treating all light-based interventions as equivalent, the paper asks which technologies can produce measurable and potentially durable changes in sebum output. The findings support the idea that only selected device categories, especially those with deeper sebaceous targeting, meaningfully reduce sebum excretion. That distinction is clinically valuable because it explains why some modalities produce short-lived improvement while others may be more promising for sustained control in oil-driven acne phenotypes (Level 1a).

Akuffo-Addo et al. [23] examines visible light in acne treatment and provides an accessible overview of blue, red, and related light exposures in their review. Its main contribution is to clarify both the appeal and the limitations of visible light strategies. These methods are attractive because they are generally noninvasive, low-cost, and well tolerated, but the review emphasizes that their biologic effect is often modest and maintenance-dependent, particularly when compared with deeper or more selective laser systems. The article is thus helpful in defining where visible light fits clinically: as a useful adjunct or lower-intensity option, but usually not as a definitive solution for more severe, sebaceous, or scarring-prone acne (Level 5).

Pulumati et al. [24] focuses on selective photothermolysis of sebaceous glands and is foundational for understanding why certain wavelengths have become central to procedural acne research in their review. By linking wavelength selection to lipid absorption and glandular anatomy, the authors explain the physical rationale for mid-infrared and related systems, including 1450 nm, 1726 nm, and 1927 nm platforms. The paper's importance lies in translating laser physics into acne-specific therapeutic logic. Rather than viewing energy delivery generically, it frames acne treatment as precision targeting of the pilosebaceous unit, thereby offering a scientific basis for the current move toward selective sebaceous photothermolysis (Level 5).

Yuan et al. [25] evaluates topical, light-based, and complementary interventions for acne and provides a high-level synthesis of a broad therapeutic landscape in their Cochrane systematic review. Its relevance to laser therapy lies in the comparative perspective: light-based interventions are assessed not in isolation but alongside other commonly used approaches. The review supports the view that phototherapy can add clinically useful benefit, especially as an adjunct to standard care, while also highlighting uncertainty created by variable protocols and uneven trial quality. Because it operates at the level of systematic review overviews, the article offers a valuable evidence map rather than device-specific technical guidance (Level 1a).

Bakircioglu et al. [26] examined whether combining plasma shower treatment with a 585 nm Q-switched laser could improve outcomes in mild-to-moderate acne vulgaris in their prospective clinical study. The report is notable for exploring a sequential, multimodal approach rather than relying on a single device platform. The authors suggest that plasma-based pretreatment may alter the superficial barrier or local tissue environment in a way that complements subsequent vascular laser exposure. Clinically, the article supports the possibility that erythematous inflammatory acne may respond particularly well to hybrid protocols, although the study design limits firm causal inference and broader generalization (Level 2b).

Mahran et al. [27] compared low-level laser therapy with polarized light for active acne, providing a direct head-to-head assessment of two noninvasive light-based modalities in this randomized controlled trial. The study is useful because it moves beyond simple before-and-after reporting and instead tests relative efficacy under the same clinical framework. According to the authors, low-level laser therapy achieved better improvement in key inflammatory outcomes and offered a stronger effect on clinically meaningful lesion reduction. The trial also adds practical information about treatment tolerability and the likely role of coherent light delivery in deeper dermal modulation, making it relevant for outpatient acne protocols (Level 1b).

Diogo et al. [28] offers a mechanistic and translational review of antimicrobial blue light in acne, with particular attention to photoinactivation of *C. acnes* through excitation of endogenous porphyrins and generation of reactive oxygen species in the book chapter. Its main strength lies in clarifying why blue light is biologically appealing yet clinically constrained. The chapter explains that antimicrobial effects are strongest in superficial disease and may be less sufficient for deeper, nodulocystic or highly sebaceous acne phenotypes. As a result, the work supports blue light as a rational component of combination regimens rather than a universal standalone solution for all severities of acne vulgaris (Level 5).

Mohammed et al. [29] evaluated a 577 nm Pro-Yellow laser for inflammatory acne and contributes to the growing interest in vascular-targeted acne treatment in this randomized clinical trial. By focusing on a wavelength with strong hemoglobin affinity, the study addresses the inflammatory and erythematous dimensions of the disease rather than sebaceous targeting alone. The authors report favorable improvement in inflammatory lesions and visible redness, suggesting that yellow light platforms may be particularly useful when persistent erythema is a dominant concern. The study is clinically interesting, although its quasi-randomized design and likely modest scale place it below the strongest level of interventional evidence (Level 2b).

Maghsoodloo et al. [30] compared Q-switched and long-pulsed fractional 1064 nm Nd:YAG lasers for active facial acne in their pilot, double-blind, randomized, controlled split-face trial. Its methodological strength is the within-patient comparison, which reduces inter-individual variability in acne severity, skin behavior, and treatment response. The report suggests that the two 1064 nm approaches may not be clinically interchangeable: longer-pulsed fractional delivery appears more favorable for deeper inflammatory disease, whereas Q-switched treatment may confer advantages for more superficial components and visible dyspigmentation. The study therefore helps refine modality selection within the Nd:YAG category rather than treating 1064 nm systems as a uniform class (Level 1b).

Olugbade et al. [31] assessed a 650-microsecond 1064 nm Nd:YAG laser for acne vulgaris and is clinically relevant because it evaluates a short-pulse format intended to balance efficacy, tolerability, and procedural convenience in their retrospective study. The authors emphasize that the treatment can be delivered with limited need for anesthesia or cumbersome adjunctive cooling, which may improve acceptability in routine practice. The findings suggest meaningful reduction in inflammatory lesions together with good patient tolerance. However, the retrospective design means the results should be interpreted cautiously, especially because uncontrolled treatment settings may obscure the contribution of prior therapies, maintenance regimens, or patient selection bias (Level 2b).

He et al. [32] compares isotretinoin combined with laser or light-based treatments against isotretinoin alone and addresses a clinically important historical concern regarding procedural safety during retinoid therapy in their meta-analysis. The pooled evidence supports the view that combination treatment can accelerate acne improvement and may reduce reliance on higher cumulative isotretinoin exposure. Another important implication is that concurrent device use may help manage inflammatory lesions and early scar change within the same treatment window. Although the included studies likely vary by device type and timing, the review meaningfully challenges older contraindication paradigms and supports more flexible integration of devices with systemic therapy (Level 1a).

Abdelwahab et al. [33] maps the most influential literature in laser treatment for acne and acne scars and therefore provides a research-level rather than patient-level contribution in their bibliometric analysis. The article documents how attention has shifted over time from older ablative approaches toward more targeted, lower-downtime technologies, including fractional systems and sebum-directed devices. It is especially useful for identifying the intellectual structure of the field, the most productive countries and journals, and the themes that have driven citation impact. While it does not test efficacy directly, the paper helps contextualize why current clinical research increasingly prioritizes selectivity, safety, and scar prevention alongside acne control (Level 5).

Ginting et al. [34] addresses a dimension often neglected in procedural acne literature: cost-effectiveness and patient satisfaction in their observational study. By comparing topical therapy alone, topical plus systemic therapy, and topical plus laser treatment, the article broadens the discussion beyond lesion counts to the economics and lived experience of care. The findings suggest that although laser-inclusive regimens require higher upfront expenditure, patients may perceive greater value because of faster visible improvement, better satisfaction, or reduced dependence on prolonged medications. The study is important for real-world practice, but conclusions are naturally limited by nonrandomized design and the influence of local healthcare costs and patient expectations (Level 2b).

Boonpethkaew et al. [35] investigated a 589/1319 nm solid-state dual-wavelength laser combined with topical benzoyl peroxide for inflammatory acne in their split-face randomized controlled trial. The trial is methodologically strong because the split-face design allows internal comparison while the addition of benzoyl peroxide reflects common real-world combination care. The dual wavelengths are intended to address more than one pathogenic axis, with vascular and sebaceous effects acting alongside topical antimicrobial therapy. The authors report superior improvement in inflammatory activity and sebum-related outcomes, supporting the concept that multi-target procedural regimens may outperform single-mechanism interventions when inflammatory acne remains active despite standard topical measures (Level 1b).

Zyoud et al. [36] charts global research trends in lasers for acne treatment from year 1986 to 2022 in their bibliometric and visual analysis. Its contribution is to show how the field has matured from scattered reports on nonspecific light exposure into a more organized body of work focused on photodynamic therapy, sebaceous targeting, and device innovation. The article identifies leading countries, collaboration networks, and topical clusters, thereby clarifying where scientific momentum has accumulated. Although bibliometric studies do not address clinical efficacy, this paper is useful for understanding the rapid rise of interest in newer wavelengths such as 1726 nm and the expanding prominence of translational procedural dermatology (Level 5).

Eltanany et al. [37] contrasted intralesional tranexamic acid with long-pulsed 1064 nm Nd:YAG laser treatment for acne vulgaris in their split-face comparative study. The design is notable because it pits a procedural laser strategy against a nonlaser injected anti-inflammatory option within the same patient, allowing more precise side-to-side clinical assessment. The report suggests that both interventions may offer benefit, but the laser arm appears more effective for structural inflammatory lesions, whereas tranexamic acid may be more helpful for visible redness or associated post-inflammatory change. This study contributes to practical decision-making when clinicians must choose between vascular modulation and broader dermal heating approaches (Level 1b).

Hong et al. [38] focuses on non-pharmacological therapeutic devices in acne management and situates laser systems within a broader ecosystem of technology-based interventions in their review. A key strength is that it acknowledges acne as a chronic disease often requiring combination strategies, including devices that target active inflammation, sebaceous activity, dyschromia, and textural sequelae. The article is particularly useful for highlighting the convergence of laser platforms with other procedural approaches such as radiofrequency. By taking this wider view, the review supports a more individualized model of device selection based on acne phenotype, cosmetic goals, and tolerance of medications rather than a one-device-fits-all paradigm (Level 5).

Mohamed et al. [39] compared a 577 nm diode laser with a 1064 nm Nd:YAG laser for inflammatory acne vulgaris in their split-face randomized study. Its value lies in directly contrasting two clinically plausible strategies: stronger vascular selectivity versus deeper dermal penetration and broader sebaceous modulation. The study suggests that the 577 nm device may produce earlier improvement in redness and superficial inflammatory lesions, while the 1064 nm platform may be better suited for deeper papules or nodulocystic activity. Such findings are important because they reinforce that wavelength choice should be based on lesion morphology and the dominant clinical problem rather than on a generic category of "laser treatment" (Level 1b).

Ginting et al. [40] compared treatment effectiveness and recovery duration among topical, topical plus systemic, and topical plus laser regimens.in their cohort analysis. The article is important because it frames acne management not only in terms of response but also in terms of how quickly patients recover from an active and visible disease phase. The authors suggest that adding laser treatment may shorten the time required to reach a cosmetically and psychologically meaningful improvement, potentially reducing social burden and dissatisfaction. Because the study is observational, confounding cannot be excluded; nevertheless, it contributes useful real-world evidence on the practical tempo of recovery under different treatment pathways (Level 2b).

Pamela et al. [41] evaluated laser-assisted targeted therapy in four adults (19–31 years) with moderate to severe acne vulgaris in their case series. Patients received topical light absorbing gold microparticle suspension delivered with sonophoresis, followed by 1500 shots of long pulsed 1064 nm Nd:YAG laser for three sessions at 2-week intervals. Two patients received a low dose of microparticles (1–2 cc), while two received a standard dose (2.5–3.5 cc). Clinical assessment two weeks after the final session showed that the standard dose group had more marked improvement in inflammatory lesions, post-acne erythema and facial oilness, with high patient satisfaction and no recurrence during short follow-up. The low dose group improved only moderately. No adverse effects were reported. The authors conclude that this approach appears safe and potentially effective, but evidence is limited by the very small uncontrolled sample and short follow-up (Level 4).

Goldberg et al. [42] provides one-year data on a 1726 nm sebum-selective laser across different skin types and represents one of the most clinically significant reports in the recent acne laser literature in their prospective multicenter study. Its central contribution is prospective evidence that a wavelength near the lipid absorption peak can improve acne while maintaining an acceptable safety profile in a heterogeneous patient population. The longitudinal follow-up adds weight to the argument that sebaceous targeting may offer more durable benefit than purely anti-inflammatory or antibacterial approaches. The study also strengthens confidence that such technology can be applied outside single-center settings with appropriate procedural safeguards (Level 2b).

Steuer et al. [43] summarizes current lasers and lights for acne in a practical, clinic-oriented format in their cosmetic surgery review. The paper is particularly useful for translating acne laser literature into everyday procedural considerations, including basic device categories, treatment intent, and supportive measures such as cooling or endpoint recognition. Although it is not a formal evidence synthesis, it reflects how acne care has increasingly intersected with aesthetic practice, especially when patients seek simultaneous management of inflammation, erythema, and early textural change. The review therefore serves as an applied overview for clinicians who incorporate acne procedures into broader facial treatment programs (Level 5).

Qiu et al. [44] examined a two-step photodynamic therapy protocol using 630 nm red light to reduce pain during treatment of facial acne in their randomized controlled trial. The study addresses one of the best-known barriers to wider use of PDT: procedural discomfort. By modifying the irradiation strategy rather than abandoning the modality, the authors showed that pain mitigation can be pursued without necessarily sacrificing therapeutic activity. This is clinically important because patient willingness to complete serial sessions is often limited by the acute pain of conventional PDT. The article therefore contributes not only efficacy data but also a meaningful refinement in treatment tolerability and protocol design (Level 1b).

Tanghetti et al. [45] evaluated a 1726 nm laser protocol using air cooling, real-time temperature monitoring, and software-assisted power adjustment to achieve selective sebaceous gland photothermolysis in their clinical trial. The paper is especially important because it focuses on controllability and safety engineering, not only on acne clearance. By integrating thermal feedback into treatment delivery, the authors sought to reach a biologically effective endpoint while minimizing collateral epidermal injury. Such work is highly relevant for the future of acne laser therapy because device precision may determine whether sebum-selective systems can be scaled safely across different operators, skin types, and clinical settings (Level 2b).

Bittar et al. [46] centers specifically on the 1726 nm laser and highlights why it has attracted major attention in acne therapeutics in their concise review. The article explains the appeal of matching wavelength selection to the absorption characteristics of sebum, thereby seeking selective sebaceous gland injury with less collateral epidermal damage than broader thermal approaches. Although brief, the paper is influential because it frames 1726 nm technology as a potentially transformative nonpharmacologic strategy for patients who would benefit from sebum suppression but wish to avoid systemic isotretinoin. It therefore functions as an early interpretive bridge between laser physics, clinical promise, and practice adoption (Level 5).

Chun et al. [47] reports use of a 1927 nm fractional thulium laser for acne vulgaris and is notable because the modality is more commonly associated with pigmentary and textural indications in their case series. The report suggests that fractional thulium treatment may influence active acne through creation of controlled microscopic thermal zones, with possible effects on follicular obstruction, superficial inflammation, and later remodeling. As a case series, it cannot establish comparative efficacy, but it raises a clinically interesting question about whether selected fractional devices may treat active lesions while also improving early residual textural change. The study is therefore hypothesis-generating and potentially practice-informing for selected cases (Level 4).

Jung et al. [48] reviews the use of lasers in acne vulgaris and serves as a broad educational synthesis rather than a primary clinical investigation in their textbook chapter. Its importance lies in organizing the field by mechanism, wavelength class, and practical treatment objective, thereby helping readers connect older and newer acne devices within one therapeutic framework. The chapter discusses how different systems address active inflammation, sebaceous activity, or scarring risk, and it reinforces the need for individualized parameter selection. Although the evidence level is inherently low, such foundational summaries remain helpful for understanding how procedural acne management is taught and conceptualized in dermatologic practice (Level 5).

Xu et al. [49] examines combinations of energy-based devices with isotretinoin for acne and acne scars, directly addressing a topic long complicated by cautionary dogma in their systematic review. The authors synthesize evidence suggesting that concurrent or overlapping use of procedural therapies with isotretinoin may be safer and more beneficial than older guidelines implied. Clinically, the review is important because it supports simultaneous management of active lesions and evolving scar burden rather than forcing a prolonged sequential approach. Even so, the included studies likely vary considerably by device type and timing, so the paper is best read as strong support for selective integration rather than blanket endorsement of all combinations (Level 1a).

Liu et al. [50] compares different pretreatment strategies before photodynamic therapy for moderate-to-severe acne and focuses on a central practical problem: how to improve photosensitizer delivery and overall PDT performance in their clinical study. By examining methods such as epidermal preparation or fractional pretreatment, the article highlights that procedural context may substantially influence PDT efficacy. The authors suggest that pretreatment modifying the barrier can improve penetration and may enhance response in more severe inflammatory disease. This is clinically meaningful because PDT outcomes are often inconsistent across centers, and differences in preparation technique may explain part of that variability. The study therefore informs protocol optimization rather than PDT efficacy alone (Level 2b).

Hu et al. [51] addresses acne-associated post-inflammatory dyschromia using a combination of nonablative laser therapy and topical antioxidants in their clinical study. Although the primary focus is not active acne lesion reduction, the paper is highly relevant because pigmentary sequelae strongly influence patient satisfaction, especially in skin of color. The report suggests that combining a procedural pigment-modulating strategy with adjunctive topical support may accelerate fading of residual discoloration while maintaining acceptable tolerability. In practical terms, the study expands the concept of acne laser therapy beyond lesion clearance to whole-disease management, including the visible aftermath that often motivates patients to seek procedural intervention (Level 2b).

Rageh et al. [52] evaluated autologous nanofat injection combined with fractional CO_2 laser for atrophic acne scars in their prospective study. While primarily a scar-management article, it remains relevant to the present review because it illustrates how acne device therapy increasingly overlaps with regenerative and combination-based treatment strategies. The addition of nanofat suggests an effort to improve tissue quality and healing alongside ablative remodeling. For readers focused on active acne, the study is less directly informative than inflammatory acne trials, but it demonstrates the expanding procedural continuum from active disease control to structural rehabilitation. Its findings are best interpreted as supportive evidence for complex post-acne management rather than first-line active acne care (Level 2b).

Saedi et al. [53] examined a 650-microsecond 1064 nm Nd:YAG laser for mild to severe acne vulgaris and adds to the literature supporting short-pulse Nd:YAG approaches in their clinical study. The report is useful because it suggests that one platform may be employed across a range of severities with acceptable tolerance, potentially improving versatility in practice. The authors present the device as capable of meaningful inflammatory lesion reduction while preserving procedural simplicity. As with other nonrandomized clinical studies, absence of a comparator limits certainty about relative superiority. Nonetheless, the paper strengthens the impression that microsecond 1064 nm Nd:YAG systems occupy a practical middle ground between efficacy, safety, and workflow feasibility (Level 2b).

Nathan et al. [54] explored ablative fractional laser treatment for clinical improvement of acne vulgaris, an unconventional but clinically provocative approach in their case series. The report suggests that localized ablative injury may facilitate rapid decompression of selected lesions while also stimulating remodeling, thereby potentially addressing active inflammation and early scarring together. Because the evidence comes from an uncontrolled case series, the article should be interpreted as exploratory rather than definitive. Even so, it is relevant for severe or refractory cases in which conventional pathways have not achieved satisfactory control. The study also illustrates how the boundary between active acne treatment and scar prevention is increasingly blurred in procedural practice (Level 4).

Ashmawy et al. [55] compared low-level laser therapy with topical erythromycin 2% in inflammatory acne vulgaris and is notable for juxtaposing a device-based approach with a common topical antibiotic standard in their randomized controlled trial. The trial suggests that low-level laser therapy can deliver at least comparable benefit for inflammatory lesions while potentially offering advantages in erythema reduction and freedom from antibiotic resistance concerns. That comparison is clinically meaningful in an era increasingly focused on antibiotic stewardship. The study also supports the use of lower-intensity procedural therapy in patients seeking non-systemic options or those who cannot tolerate conventional topical regimens, though broader validation remains desirable (Level 1b).

Lim et al. [56] evaluated solid-state dual-wavelength lasers for moderate-to-severe inflammatory acne in Asian populations and is especially important for its attention to safety in more pigment-prone skin types in their clinical study. The article suggests that appropriate dosimetry can achieve clinically meaningful improvement while limiting post-inflammatory hyperpigmentation risk, a key issue that often restricts aggressive laser use in darker phototypes. By focusing on an Asian cohort, the study contributes population-specific guidance that is often missing from acne laser literature dominated by lighter skin samples. Its practical significance lies in showing that effective procedural acne treatment can be adapted thoughtfully to pigment-sensitive patients (Level 2b) (Table 1).

Table 1. Summary of Literature on Clinical Application of Laser for Acne Vulgaris.

Author/Year	Study Design	Key Findings	Evidence Level
Ren et al., 2026 [15]	Narrative review	Organized contemporary acne phototherapy into sebum modulation, inflammation control, and scar management, emphasizing wavelength-specific biologic targeting and mechanism-based procedural therapy.	5
Jafarzadeh et al., 2025 [16]	Systematic review	Vascular lasers improved inflammatory papules/pustules and residual erythema, supporting their use for inflammatory acne phenotypes, although protocols remained heterogeneous.	1a
Huerth et al., 2025 [17]	Clinical review	Highlighted practical laser selection in diverse skin types, especially skin of color, emphasizing longer wavelengths, conservative fluence, and cooling to reduce dyschromia risk.	5
Ishii et al., 2025 [18]	Clinical review	Integrated light- and laser-based treatments into office practice, outlining patient selection and distinguishing microbial, inflammatory, and sebaceous targets.	5
Pour Mohammad et al., 2025 [19]	Systematic review	Reviewed efficacy, safety, tolerability, and relapse across modern procedural therapies, noting that durability appears greater when treatments alter sebaceous function rather than only transiently suppress inflammation.	1a
Xu et al., 2025 [20]	Mechanistic review	Explained how light and laser therapy may modify the sebaceous gland microecosystem, including sebum composition, microbial balance, and inflammatory signaling.	5
Jean-Pierre et al., 2024 [21]	Narrative review	Described the shift from older broad phototherapy to newer mechanism-driven lasers targeting sebaceous glands, vasculature, and scar prevention.	5
Jaalouk et al., 2024 [22]	Systematic review	Found that only selected energy-based devices meaningfully reduced sebum output, supporting deeper sebaceous targeting as a key determinant of sustained acne control.	1a
Akuffo-Addo et al., 2024 [23]	Review	Visible light therapies were generally safe and well tolerated but had modest, maintenance-dependent effects compared with deeper or more selective laser systems.	5
Pulumati et al., 2024 [24]	Review	Clarified the rationale of selective sebaceous photothermolysis and explained why wavelengths such as 1450 nm, 1726 nm, and 1927 nm have become important in acne research.	5
Yuan et al., 2024 [25]	Cochrane overview of systematic reviews	Showed that light-based interventions can provide useful adjunctive benefit, but trial quality and protocol variability limit strong comparative conclusions.	1a
Bakircioglu et al., 2026 [26]	Prospective clinical study	Suggested that plasma shower combined with 585 nm Q-switched laser may improve mild-to-moderate inflammatory acne through a multimodal sequential approach.	2b
Mahran et al., 2026 [27]	Randomized controlled trial	Low-level laser therapy outperformed polarized light for active acne, with better inflammatory lesion reduction and acceptable tolerability.	1b
Diogo, 2026 [28]	Book chapter/mechanistic review	Supported antimicrobial blue light as biologically plausible through porphyrin-mediated *C. acnes* photoinactivation, but noted limited utility in deeper or highly sebaceous acne.	5
Mohammed et al., 2026 [29]	Quasi-randomized clinical trial	577 nm Pro-Yellow laser improved inflammatory lesions and visible erythema, supporting yellow vascular-targeted devices for inflammatory acne.	2b
Maghsoodloo et al., 2026 [30]	Double-blind randomized split-face trial	Long-pulsed fractional 1064 nm Nd:YAG appeared more favorable for deeper inflammatory acne, while Q-switched treatment may better address superficial lesions and dyspigmentation.	1b

Table 1. *Cont.*

Author/Year	Study Design	Key Findings	Evidence Level
Olugbade et al., 2025 [31]	Retrospective study	A 650-microsecond 1064 nm Nd:YAG laser produced meaningful inflammatory lesion reduction with good tolerability and practical outpatient workflow.	2b
He et al., 2025 [32]	Meta-analysis	Combining isotretinoin with laser/light-based treatments accelerated improvement versus isotretinoin alone and challenged older safety concerns about concurrent procedural therapy.	1a
Abdelwahab et al., 2025 [33]	Bibliometric analysis	Showed that acne laser research has shifted from older ablative approaches toward more selective, lower-downtime technologies and scar-preventive strategies.	5
Ginting et al., 2025 [34]	Observational study	Compared cost-effectiveness and satisfaction across topical, systemic, and laser-inclusive regimens, suggesting higher upfront laser cost may be offset by greater patient-perceived value.	2b
Boonpethkaew et al., 2025 [35]	Split-face randomized controlled trial	A 589/1319 nm dual-wavelength laser plus benzoyl peroxide improved inflammatory acne and sebum-related outcomes, supporting multi-target combination therapy.	1b
Zyoud et al., 2025 [36]	Bibliometric and visual analysis	Demonstrated the maturation of acne laser research toward photodynamic therapy, sebaceous targeting, and device innovation, with growing interest in newer wavelengths such as 1726 nm.	5
Eltanany et al., 2025 [37]	Split-face comparative study	Both intralesional tranexamic acid and long-pulsed 1064 nm Nd:YAG were beneficial, but the laser appeared more effective for structural inflammatory lesions.	1b
Hong et al., 2025 [38]	Review	Positioned lasers within a broader non-pharmacologic device ecosystem and supported individualized device selection based on acne phenotype, dyschromia, and scar risk.	5
Mohamed et al., 2025 [39]	Split-face randomized study	577 nm diode laser appeared better for early erythema and superficial inflammatory lesions, whereas 1064 nm Nd:YAG was more suitable for deeper papules/nodules.	1b
Ginting et al., 2025 [40]	Cohort analysis	Laser-inclusive regimens may shorten recovery time to cosmetically meaningful improvement compared with topical-only or topical-plus-systemic strategies.	2b
Pamela et al., 2025 [41]	Case series	Four-patient case series suggests gold microparticles plus long-pulsed 1064-nm Nd:YAG laser may safely improve moderate-to-severe acne, with better short-term outcomes at standard versus low doses.	4
Goldberg et al., 2025 [42]	Prospective multicenter study	One-year data supported the safety and efficacy of the 1726 nm sebum-selective laser across different skin types, with evidence of durable benefit.	2b
Steuer et al., 2025 [43]	Practical review	Summarized acne laser and light devices in a clinic-oriented format, emphasizing device category, treatment intent, procedural endpoints, and cooling measures.	5
Qiu et al., 2025 [44]	Randomized controlled trial	A two-step 630 nm photodynamic therapy protocol reduced treatment pain while maintaining therapeutic utility, addressing a key barrier to wider PDT adoption.	1b
Tanghetti et al., 2025 [45]	Clinical trial	A 1726 nm laser with air cooling, real-time temperature monitoring, and software-assisted power adjustment improved treatment precision and safety during sebaceous photothermolysis.	2b
Bittar et al., 2024 [46]	Concise review	Highlighted the 1726 nm laser as a potentially transformative nonpharmacologic treatment by matching wavelength selection to sebum absorption characteristics.	5

Table 1. *Cont.*

Author/Year	Study Design	Key Findings	Evidence Level
Chun et al., 2024 [47]	Case series	Suggested that 1927 nm fractional thulium laser may improve active acne and early textural change through microscopic thermal zones affecting follicular obstruction and remodeling.	4
Jung et al., 2024 [48]	Textbook chapter	Provided a broad educational overview of acne lasers organized by mechanism, wavelength class, and treatment objective.	5
Xu et al., 2024 [49]	Systematic review	Supported the selective combination of energy-based devices with isotretinoin for acne and acne scars, challenging older contraindication paradigms.	1a
Liu et al., 2024 [50]	Clinical study	Different pretreatment strategies affected photodynamic therapy efficacy, suggesting barrier modification may improve photosensitizer delivery and outcomes in moderate-to-severe acne.	2b
Hu et al., 2024 [51]	Clinical study	Combination nonablative laser therapy and topical antioxidants improved acne-associated post-inflammatory dyschromia, expanding laser use beyond active lesion reduction alone.	2b
Rageh et al., 2024 [52]	Prospective study	Autologous nanofat plus fractional CO_2 laser improved atrophic acne scars, illustrating the growing overlap between post-acne rehabilitation and combination procedural therapy.	2b
Saedi et al., 2024 [53]	Clinical study	A 650-microsecond 1064 nm Nd:YAG laser was effective across mild-to-severe acne with acceptable tolerability, supporting its practical versatility.	2b
Nathan et al., 2024 [54]	Case series	Ablative fractional laser showed exploratory benefit for active acne, potentially combining lesion improvement with early remodeling, though evidence remained preliminary.	4
Ashmawy et al., 2024 [55]	Randomized controlled trial	Low-level laser therapy achieved at least comparable benefit to topical erythromycin 2% for inflammatory acne while avoiding antibiotic resistance concerns.	1b
Lim et al., 2024 [56]	Clinical study	Dual-wavelength solid-state lasers improved moderate-to-severe inflammatory acne in Asian patients with acceptable pigmentary safety under careful dosimetry.	2b

4. Discussion

The present review indicates that laser and light-based therapy for acne vulgaris is no longer best understood as a marginal adjunct reserved for refractory cosmetic cases, but rather as an increasingly mechanism-oriented therapeutic category with distinct roles across inflammatory control, sebaceous modulation, erythema reduction, and early scar prevention. Recent literature from 2024 to 2026 consistently shows a conceptual shift away from viewing "phototherapy" as a single class effect and toward matching wavelength, pulse structure, and delivery system to the dominant pathogenic and clinical phenotype of acne [15,38,48]. This evolution is important because one of the major weaknesses of earlier acne device literature was the tendency to pool biologically dissimilar interventions under broad labels, obscuring why some approaches produced only transient improvement whereas others appeared capable of more durable control [19,20,41]. The newer evidence instead supports a phenotype-based model in which vascular lasers are most relevant for inflammatory papules, pustules, and persistent erythema; 1064 nm Nd:YAG systems offer broader utility for deeper lesions and remodeling; and sebaceous-targeted mid-infrared devices, particularly the 1726 nm platform, represent the strongest advance in addressing a central driver of disease rather than simply treating its visible consequences [16,20,46].

A major theme emerging from the reviewed studies is that durability of response appears closely linked to how directly a device modifies sebaceous gland biology. Mechanistic reviews emphasized that the pilosebaceous unit should be regarded as a microenvironment whose behavior depends not only on sebum quantity, but also on lipid composition, microbial ecology, and inflammatory signaling [20]. Systematic reviews focused on sebum similarly concluded that only selected energy-based devices produce measurable changes in sebum output, helping explain why some treatments require repeated maintenance while others may sustain remission longer [22]. This distinction is echoed in broader evidence syntheses, which noted that modalities acting mainly through superficial antibacterial or anti-inflammatory effects often achieve early lesion reduction but less reliable long-term suppression than those capable of meaningful sebaceous alteration [19,41]. In that context, the emergence of selective sebaceous photothermolysis has genuine paradigm-shifting potential. Reviews by Pulumati et al. and Bittar et al. framed wavelength selection around lipid absorption and gland anatomy, providing a coherent physical rationale for why 1726 nm systems may achieve a more disease-specific effect than older nonspecific heating strategies [24,46].

The strongest support for this sebaceous-targeting approach comes from recent clinical studies of the 1726 nm laser. Goldberg et al. reported one-year prospective multicenter data showing meaningful acne improvement with acceptable safety across skin types, an especially important finding because multicenter follow-up and heterogeneous patient inclusion move the technology beyond proof-of-concept toward real-world plausibility [42]. Tanghetti et al. further strengthened this field by demonstrating that efficacy must be considered together with delivery precision: air cooling, real-time temperature monitoring, and software-assisted power adjustment were used to achieve a thermal endpoint consistent with sebaceous photothermolysis while minimizing collateral injury [45]. Taken together, these studies suggest that 1726 nm devices may become the most biologically rational nonpharmacologic option for patients with sebum-driven inflammatory acne, particularly those who cannot tolerate or prefer to avoid oral isotretinoin. At the same time, enthusiasm should remain measured. Although these results are promising, broader standardization is still lacking, and questions remain regarding relapse beyond one year, optimal retreatment intervals, comparative effectiveness against established systemic regimens, and cost barriers to widespread access [19,22,46].

Vascular-targeted lasers constitute another important area of progress, particularly for inflammatory acne phenotypes dominated by erythematous papules, pustules, and lingering post-inflammatory erythema. The systematic review by Jafarzadeh et al. concluded that vascular lasers can reduce inflammatory lesion persistence and improve residual redness, supporting the idea that acne is not merely a sebaceous or microbial disorder but also a vascular-inflammatory one [16]. This concept is reinforced by trials of yellow-spectrum devices. Mohammed et al. found favorable outcomes with a 577 nm Pro-Yellow laser in inflammatory acne, especially in relation to visible redness [29], while Mohamed et al., in a split-face randomized study, suggested that 577 nm treatment may outperform 1064 nm Nd:YAG for earlier improvement of superficial inflammatory lesions and erythema, whereas Nd:YAG may be preferable for deeper lesions [39]. Boonpethkaew et al. extended this line of evidence by showing that a 589/1319 nm dual-wavelength system combined with topical benzoyl peroxide improved inflammatory activity and sebum-related outcomes, highlighting the value of multi-target strategies rather than single-pathway intervention [35]. These findings are clinically meaningful because many patients judge treatment success not only by lesion counts but also by how quickly redness subsides and the skin appears socially presentable again.

Nonetheless, the vascular laser literature also illustrates a central limitation of the current evidence base: heterogeneity in parameters, session number, adjunctive therapy, and endpoints makes it difficult to determine whether apparent superiority reflects wavelength-specific biology or simply protocol variation [16,19,25]. Bakircioglu et al. explored a hybrid approach combining plasma shower with 585 nm Q-switched laser, suggesting additional benefit in mild-to-moderate acne [26], but such studies are difficult to generalize because multimodal designs complicate attribution of effect. Even so, the cumulative direction of evidence is convincing enough to support vascular lasers as rational tools when inflammation and erythema are dominant treatment targets, especially in patients who prioritize rapid visible improvement or have residual redness despite otherwise adequate acne control [16,35,39].

The Nd:YAG family remains one of the most versatile device categories in acne management, but recent work makes clear that 1064 nm platforms should not be treated as a homogeneous class. Maghsoodloo et al. showed in a split-face randomized trial that Q-switched and long-pulsed fractional 1064 nm Nd:YAG lasers may serve different clinical purposes, with fractional long-pulsed delivery appearing more suitable for deeper inflammatory disease and Q-switched exposure potentially better for superficial lesions and dyspigmentation-related concerns [30]. Retrospective and prospective clinical studies of 650-microsecond 1064 nm Nd:YAG systems also reported meaningful benefit with acceptable tolerability and relatively practical workflow demands [31,53]. Comparative work against nonlaser options is equally informative: Eltanany et al. found that long-pulsed 1064 nm Nd:YAG may be more effective than intralesional tranexamic acid for structural inflammatory lesions, though tranexamic acid may offer benefits for redness and post-inflammatory change [37]. These studies collectively suggest that Nd:YAG devices occupy an important middle ground in acne therapy by combining sufficient dermal penetration to address deeper inflammation with a safety profile that can be adapted across a range of severities and, potentially, pigment-prone populations when conservative settings are used [17,30,53].

Visible light and lower-intensity photobiomodulatory approaches remain relevant, but the recent literature positions them more clearly as adjuncts than as definitive monotherapies for moderate-to-severe disease. Akuffo-Addo et al. emphasized that blue and red visible light are attractive because they are noninvasive, accessible, and well tolerated, yet their effect is often modest and maintenance dependent [23]. Diogo's mechanistic discussion of antimicrobial blue light explains why: photoinactivation of *C. acnes* through endogenous porphyrins is biologically plausible, but this approach is inherently better suited to superficial disease than to deep, highly sebaceous, or nodulocystic phenotypes [28]. Randomized comparisons provide further perspective. Mahran et al. reported that low-level laser therapy outperformed polarized light for active acne [27], while Ashmawy et al. found low-level laser therapy at least comparable to topical erythromycin 2% for inflammatory acne, an especially relevant result in the era of antibiotic stewardship [55]. These findings support use of lower-intensity light-based modalities in patients seeking non-systemic treatment, those intolerant of standard topicals, or clinical contexts where safety and convenience outweigh the need for maximal sebaceous suppression. However, they do not suggest that such modalities can replace more targeted devices in severe, relapse-prone, or scar-forming acne [23,55].

Photodynamic therapy (PDT) continues to occupy a somewhat intermediate position between broad-spectrum light therapy and more selective laser systems. Its efficacy can be meaningful, particularly in moderate-to-severe inflammatory acne, but variability in pretreatment methods, photosensitizer delivery, pain burden, and irradiation protocols has limited standardization [19,25,50]. Two recent studies are therefore especially notable because they focus on optimization rather than simple efficacy claims. Liu et al. showed that pretreatment strategy may materially affect PDT performance, likely by modifying barrier properties and improving photosensitizer penetration [50]. Qiu et al. addressed one of PDT's major practical drawbacks by demonstrating that a two-step 630 nm red-light protocol can reduce treatment-associated pain [44]. These advances are clinically important because tolerability is often the limiting factor preventing completion of serial sessions. Even so, PDT still faces stronger barriers to routine adoption than simpler laser systems, and future progress will likely depend less on proving that PDT works and more on identifying reproducible protocols that balance efficacy, comfort, and efficiency [44,50].

Another major change in the contemporary literature is the weakening of older concerns about combining devices with isotretinoin. Both He et al. and Xu et al. concluded that laser/light-based treatments used with isotretinoin can enhance improvement and may be safer than older dogma suggested [32,49]. This is a significant clinical development because rigid sequencing of systemic retinoids and procedures has historically delayed treatment of active inflammation, erythema, and evolving scar burden. The new evidence does not justify indiscriminate device use with isotretinoin, since studies remain heterogeneous by modality and timing, but it does support a more nuanced, case-based approach rather than blanket avoidance [32,49]. In practice, this could allow earlier intervention for patients at high risk of scarring or those needing faster improvement without escalation to higher cumulative isotretinoin doses.

Safety across diverse skin phototypes remains central to judging the real-world value of acne laser therapy. Reviews focused on skin of color emphasized the importance of longer wavelengths, conservative fluence selection, epidermal protection, and cooling strategies to reduce the risk of post-inflammatory hyperpigmentation and blistering [17]. Lim et al. contributed important population-specific evidence by demonstrating that dual-wavelength solid-state lasers can be used effectively in Asian patients with acceptable pigmentary safety when dosimetry is carefully controlled [56]. Hu et al. broadened the discussion by addressing acne-associated post-inflammatory dyschromia, showing that nonablative laser therapy combined with topical antioxidants may improve the visible aftermath of acne, not merely active lesions [51]. This is highly relevant because patient dissatisfaction often persists even when inflammation subsides, particularly in pigment-prone skin. Thus, modern acne laser therapy should be judged by a broader outcome framework that includes erythema, dyschromia, downtime, and patient perception of complexion recovery, not simply inflammatory lesion counts [17,51,56].

Finally, this review highlights persistent evidence gaps. Despite several randomized and split-face trials, many studies remain small, single-center, or nonrandomized, and bibliometric analyses confirm that innovation has outpaced standardization [33,36]. Cost-effectiveness data are still limited, although observational work suggests that patients may value laser-inclusive regimens because of faster visible improvement and reduced treatment fatigue [34,40]. The field also increasingly overlaps with scar prevention and rehabilitation, as illustrated by work on thulium lasers, ablative fractional approaches, and combination regenerative strategies [47,52,54]. These directions are promising, but they further complicate interpretation by blending treatment of active acne with treatment of its sequelae. Future trials should therefore stratify patients by acne phenotype, skin phototype, scar risk, and sebum dominance; use standardized outcome measures including relapse and quality of life; and directly compare device-based strategies against optimized pharmacologic regimens and against each other [19,25,42]. Until such data are available, the strongest evidence supports a pragmatic conclusion: acne laser therapy is most effective when used not generically, but selectively—matching device physics to disease biology and patient context.

5. Conclusions

In conclusion, the clinical application of laser and light-based therapies for acne vulgaris has matured from a supplementary aesthetic option to a fundamental, highly effective therapeutic pillar. The period between 2024 and 2026 has witnessed critical validations of sebum-selective 1726 nm lasers, advancements in vascular targeting, and the safe integration of devices with systemic pharmacology. By offering targeted, non-systemic interventions capable of altering the pathogenic microecosystem of the pilosebaceous unit, these technologies provide vital alternatives for patients facing the limitations and toxicities of traditional medical management. Continued refinement of clinical protocols, particularly tailored to diverse skin phototypes, alongside rigorous long-term outcome studies, will further solidify the indispensable role of lasers in the modern dermatological management of acne vulgaris.

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References

1. Lynn, D.D.; Umari, T.; Dellavalle, R.P.; Dunnick, C. The epidemiology of acne vulgaris in late adolescence. *Adolesc. Health Med. Ther.* **2016**, *7*, 13–25. [CrossRef] [PubMed]
2. Ghasemiyeh, P.; Noorizadeh, K.; Dehghan, D.; Rasekh, S.; Zadmehr, O.; Mohammadi-Samani, S. The role of different factors in pathophysiology of acne and potential therapeutic options: A brief review. *Trends Pharm. Sci. Technol.* **2022**, *8* (2), 107–118.
3. Eichenfield, D.Z.; Sprague, J.; Eichenfield, L.F. Management of acne vulgaris: A review. *JAMA* **2021**, *326* (20), 2055–2067. [CrossRef]
4. Suuberg, A. Psychiatric and developmental effects of isotretinoin (retinoid) treatment for acne vulgaris. *Curr. Ther. Res.* **2019**, *90*, 27–31. [CrossRef]
5. Li, M.K.; Liu, C.; Hsu, J.T.S. The use of lasers and light devices in acne management: An update. *Am. J. Clin. Dermatol.* **2021**, *22* (6), 785–800. [CrossRef] [PubMed]
6. Zdrada, J.; Stolecka-Warzecha, A.; Odrzywołek, W.; Deda, A.; Błońska-Fajfrowska, B.; Wilczyński, S. The use of light in the treatment of acne vulgaris—A review. *J. Cosmet. Dermatol.* **2021**, *20* (12), 3788–3792. [CrossRef]
7. Brown, E.R. Fundamentals of lasers and light devices in dermatology. In *Practical Introduction to Laser Dermatology*; Springer International Publishing: Cham, Switzerland, 2020; pp. 1–52.
8. Zouboulis, C.C.; Picardo, M.; Ju, Q.; Kurokawa, I.; Törőcsik, D.; Bíró, T.; Schneider, M.R. Beyond acne: Current aspects of sebaceous gland biology and function. *Rev. Endocr. Metab. Disord.* **2016**, *17* (3), 319–334. [CrossRef]
9. Nunez, J.H.; Strong, A.L.; Comish, P.; Hespe, G.E.; Harvey, J.; Sorkin, M.; Levi, B. A review of laser therapies for the treatment of scarring and vascular anomalies. *Adv. Wound Care* **2023**, *12* (2), 68–84. [CrossRef]
10. Salameh, F.; Shumaker, P.R.; Goodman, G.J.; Spring, L.K.; Seago, M.; Alam, M.; Al-Niaimi, F.; Cassuto, D.; Chan, H.H.; Dierickx, C.; et al. Energy-based devices for the treatment of Acne Scars: 2022 International consensus recommendations. *Lasers Surg. Med.* **2022**, *54* (1), 10–26.
11. Choi, Y.-J.; Kim, J.Y.; Nam, J.-H.; Lee, G.-Y.; Kim, W.-S. Clinical outcome of 1064-nm picosecond neodymium–doped yttrium aluminium garnet laser for the treatment of hypertrophic scars. *J. Cosmet. Laser Ther.* **2019**, *21* (2), 91–98.
12. Scopelliti, M.G.; Kothare, A.; Karavitis, M. A novel 1726-nm laser system for safe and effective treatment of acne vulgaris. *Lasers Med. Sci.* **2022**, *37* (9), 3639–3647. [CrossRef] [PubMed]
13. Sowash, M.; Alster, T. Review of laser treatments for post-inflammatory hyperpigmentation in skin of color. *Am. J. Clin. Dermatol.* **2023**, *24* (3), 381–396. [CrossRef]
14. Centre for Evidence-Based Medicine. Oxford Centre for Evidence-Based Medicine: Levels of Evidence (March 2009) [Internet]. Oxford: University of Oxfod; c2009. Available online: https://www.cebm.ox.ac.uk/resources/levels-of-evidence/oxford-centre-for-evidence-based-medicine-levels-of-evidence-march-2009 (accessed on 6 May 2026).
15. Ren, X.; Ge, L.; Song, Z. Phototherapy for Acne Vulgaris: Strategies and Clinical Applications in Sebum Modulation, Inflammation Control, and Scar Management. *Photobiomodul. Photomed. Laser Surg.* **2026**, *44*, 345–358. [CrossRef]
16. Jafarzadeh, A.; Heidari, S.; Omid, R.; Goodarzi, A. Systematic review of vascular lasers for the treatment of inflammatory active acne vulgaris. *Lasers Med. Sci.* **2025**, *40* (1), 168. [CrossRef]
17. Huerth, K.; Ohanenye, C.; Quartey, A.; Jackson, B.; Callender, V. Established and emerging laser treatments for acne vulgaris in diverse skin types. *J. Clin. Aesthetic Dermatol.* **2025**, *18* (6), 41–48.
18. Ishii, L.; Deoghare, S.; Boen, M. Light and laser-based therapy in treatment of acne vulgaris: A clinical review. *J. Am. Acad. Dermatol.* **2025**, *93*, 1058–1064. [PubMed]
19. Pour Mohammad, A.; Seirafianpour, F.; Jafarzadeh, A.; Ghahari, S.; Noroozi, E.; Nazerian, A.H.; Jamshidi Naeini, A.; Shokraee, K.; Mashayekhi, F.; Mortaja, M.; et al. A comprehensive systematic review on the efficacy, safety, tolerability, and relapse rates of modern procedural therapies for inflammatory and non-inflammatory acne vulgaris. *Lasers Med. Sci.* **2025**, *40* (1), 383. [CrossRef] [PubMed]
20. Xu, J.; Huang, S.; Fu, Z.; Zheng, W.; Luo, W.; Zhuang, N.; Liu, L.; He, R.; Yang, F. Effects of light and laser therapies on the microecosystem of sebaceous glands in acne treatment. *Photodermatol. Photoimmunol. Photomed.* **2025**, *41* (1), e70005. [CrossRef]
21. Jean-Pierre, P.; Tordjman, L.; Ghodasara, A.; Nwosu, C.; Nouri, K. Emerging lasers and light-based therapies in the management of acne: A review. *Lasers Med. Sci.* **2024**, *39* (1), 245.
22. Jaalouk, D.; Pulumati, A.; Algarin, Y.A.; Humeda, J.; Goldberg, D.J. The impact of energy-based devices on sebum in acne vulgaris: A systematic review. *J. Cosmet. Dermatol.* **2024**, *23* (10), 3066–3077. [CrossRef]
23. Akuffo-Addo, E.; Ramsay, K.; Mohsen, S.; Boisvert, J.; Mukovozov, I. Visible light in the treatment of acne vulgaris. *J. Cutan. Med. Surg.* **2024**, *28* (6), 567–571. [CrossRef] [PubMed]

24. Pulumati, A.; Jaalouk, D.; Algarin, Y.A.; Kasheri, E.; Issa, N.T.; Nouri, K. Targeting sebaceous glands: A review of selective photothermolysis for Acne Vulgaris treatment. *Arch. Dermatol. Res.* **2024**, *316* (7), 356. [CrossRef]
25. Yuan, Y.; Wang, Y.; Xia, J.; Liu, H.; Liu, J.P.; Li, D.; Wang, R.; Sang, H.; Cao, H. Topical, light-based, and complementary interventions for acne: An overview of systematic reviews. *Cochrane Database Syst. Rev.* **2024**, *10*, CD014918.
26. Bakircioglu, C.A.; Turkmen, D.; Altunisik, N.; Kanat, Z.; Sener, S.; Colak, C. Evaluation of the Efficacy of Plasma Shower and 585 Nm Q-Switched Laser in the Treatment of Mild to Moderate Acne Vulgaris. *J. Cosmet. Dermatol.* **2026**, *25* (4), e70876. [CrossRef]
27. Mahran, H.G.; El Gawad, S.M.M.A.; Mashaly, M.E.S.; Elsayed, A.G. Low Level Laser Versus Polarized Light in the Treatment of Acne Vulgaris. *Egypt. J. Phys. Ther. Rehabil.* **2026**, *6* (1), 18–29. [CrossRef]
28. Diogo, M.L.G. Antimicrobial Blue Light and Acne Vulgaris: Unraveling Therapeutic Insights. In *Handbook of Antimicrobial Photoinactivation*; Springer Nature Switzerland: Cham, Switzerland, 2026; pp. 1–32.
29. Mohammed, R.S.H.; Helmi, R.R.; Al-Samarraee, M.F.; Al-Sabak, H. Effectiveness of 577-nm Pro-Yellow Laser in Managing Inflammatory Acne: Results from a Quasi-Randomized Clinical Trial. *Al-Rafidain J. Med. Sci.* **2026**, *10* (2), 152–158. [CrossRef]
30. Maghsoodloo, D.; Jafarzadeh, A.; Ghassemi, M.; Sadeghzadeh-Bazargan, A.; Goodarzi, A. Comparison of the Efficacy of Q-Switched Versus Long-Pulsed Fractional 1064 nm Nd:YAG Laser in the Treatment of Active Facial Acne: A Pilot, Double-Blind, Randomized, Controlled, Split-Face Study. *Health Sci. Rep.* **2026**, *9* (4), e72354. [CrossRef] [PubMed]
31. Olugbade, I.D.; Petty, A.C.; Imahiyerobo-Ip, J. Treatment of Acne Vulgaris With a 650-ms, 1064-nm Nd:YAG Laser: A Retrospective Study. *J. Cosmet. Dermatol.* **2025**, *24* (2), e16711. [CrossRef]
32. He, S.; Wang, Y.; Wang, J.; Tang, L.; Yang, L.; Ye, F. Isotretinoin Combined Laser/Light-Based Treatments Versus Isotretinoin Alone for the Treatment of Acne Vulgaris: A Meta-Analysis. *J. Cosmet. Dermatol.* **2025**, *24* (1), e16639. [CrossRef]
33. Abdelwahab, S.I.; Taha, M.M.E.; Farasani, A.; Abdullah, S.M.; Moshi, J.M.; A Khamjan, N.; Assiri, A.; Alshahrani, S.; A Sahli, K.; Qadri, M.; et al. The most influential research in laser therapy for acne and acne scars: A bibliometric analysis. *Lasers Med. Sci.* **2025**, *40* (1), 371. [CrossRef]
34. Ginting, I.; Mukhali, H.B.; Sinaga, R.P.; Dakhi, T.; Aji, A.B.; Supit, N.; Ni Rudang, S.; Lubis, S.; Bin Abas, M.I. Evaluation of Cost-Effectiveness and Patient Satisfaction of Topical, Topical Plus Systemic, and Topical Plus Laser Treatment in Patients with Acne Vulgaris High Level. *J. La Medihealtico* **2025**, *6* (6), 1553–1573. [CrossRef]
35. Boonpethkaew, S.; Ratanapokasatit, Y.; Chirasuthat, S.; Wattanakrai, P. Efficacy and safety of the 589/1319 nm solid-state dual-wavelength laser combined with topical benzoyl peroxide for inflammatory acne vulgaris: A split-face randomized controlled trial. *Arch. Dermatol. Res.* **2025**, *317* (1), 635. [CrossRef]
36. Zyoud, S.H.; Taha, S.; Zyoud, S.; Shahwan, M.; Jairoun, A.A.; Al-Jabi, S.W. Global research trends and hotspots in the application of lasers for acne treatment from 1986 to 2022: Bibliometric and visual analysis. *Lasers Med. Sci.* **2025**, *40* (1), 88. [CrossRef] [PubMed]
37. Eltanany, H.H.M.; Qawy, F.A.W.A.; Hamdino, M.; Ali, M.S. A split face study comparing intralesional tranexamic acid versus 1064 nm long pulsed Nd:YAG laser for acne vulgaris treatment. *Arch. Dermatol. Res.* **2025**, *317* (1), 709. [CrossRef] [PubMed]
38. Hong, J.Y.; Seok, J.; Han, H.S.; Park, K.Y. Emerging innovations in acne management: A focus on non-pharmacological therapeutic devices. *J. Korean Med. Sci.* **2025**, *40* (9), e118. [CrossRef]
39. Mohamed, E.M.; Abdel-Aleem, H.L.; Elazab, G.M.H.; Rageh, M.A. Comparative efficacy and safety of 577-nm diode laser versus 1064-nm Nd:YAG laser for inflammatory acne vulgaris: A split-face randomized study. *Lasers Med. Sci.* **2025**, *40* (1), 422. [CrossRef]
40. Ginting, I.; Mukhali, B.; Basri, H.; Abas, B.; Ihsanuddin, M.; Aji, A.; Rudang, S.N. Comparison of Effectiveness and Duration of Recovery of Acne Vulgaris Treatment Using a Topical, Topical Plus Systemic, and Topical Plus Laser. *J. Int. Crisis Risk Commun. Res. (JICRCR)* **2025**, *8* (2), 147.
41. Pamela, R.; Sutanto, M.; Christanty, A.; Ervina, E.; Lee, H.; Sutanto, M. Targeted Acne Therapy Using Light-Absorbing Gold Microparticles Combined With Long-Pulsed 1064 nm Nd: YAG Laser: Case Series. *Cureus* **2025**, *17* (12), e98929.
42. Goldberg, D.; Ronan, S.; Bhatia, A.; Dhawan, S.S.; Green, J.B.; Kilmer, S.L.; Kwan, W.; Gold, L.S.; Weiss, J.S.; Doucette, M.; et al. Safe and effective acne treatment across skin types with a 1726 nm sebum-selective laser: One year data from a prospective multicenter study. *J. Am. Acad. Dermatol.* **2025**, *94*, 517–524. [CrossRef] [PubMed]
43. Steuer, A.B.; Rajanala, S.; Saedi, N.; Dover, J.S. Lasers and Lights for Acne. *Adv. Cosmet. Surg.* **2025**, *8* (1), 69–76. [CrossRef]
44. Qiu, S.; Wang, Y.; Lu, J.; Jiang, G. Two-step photodynamic therapy for facial acne: A randomized controlled trial of pain reduction with 630 nm red light laser. *Lasers Med. Sci.* **2025**, *40* (1), 178.
45. Tanghetti, E.A.; Sierra, R.; Estes, M.; Eck, A.; Intintoli, A.; Hofvander, H.; Cohen, J.L.; Friedmann, D.P.; Goldman, M.P.; Pomerantz, H.; et al. Treatment of Acne With a 1726 nm Laser, Air Cooling, and Real-Time Temperature Monitoring, Software-Assisted Power Adjustment to Achieve a Temperature Endpoint With Selective Sebaceous Gland Photothermolysis. *Lasers Surg. Med.* **2025**, *57* (3), 236–251. [CrossRef] [PubMed]
46. Bittar, J.; Hooper, P.; Dover, J.S. 1726 nm Lasers for the Treatment of Acne Vulgaris. *Skin Ther. Lett.* **2024**, *29* (1), 5–7.
47. Chun, S.I. A novel treatment of acne vulgaris using a 1927 nm fractional thulium laser: A case series. *Clin. Cosmet. Investig. Dermatol.* **2024**, *17*, 1931–1942. [CrossRef]
48. Jung, J.Y.; Suh, D.H. Use of Lasers in Acne Vulgaris. In *Updates on Lasers in Dermatology*; Springer Nature Switzerland: Cham, Switzerland, 2024; pp. 113–128.
49. Xu, Y.; Wang, H.; Guo, L.; Hamblin, M.R.; Wen, X. Combinations of Energy-based Devices plus isotretinoin for management of acne and acne scars: A systematic review. *J. Cosmet. Dermatol.* **2024**, *23* (10), 3090–3101. [CrossRef]
50. Liu, Y.; Sun, D.-D.; Chang, S.-Y.; Ma, L.-L.; Jiang, G. Study of different pre-treatments in the comparison of the efficacy of photodynamic therapy for moderate to severe acne vulgaris. *Photodiagnosis Photodyn. Ther.* **2024**, *49*, 104298. [CrossRef]
51. Hu, J.K.; Quinonez, R.L.; Antasiuk, V.; Waibel, J. Treatment of Acne Vulgaris-Associated Post-Inflammatory Dyschromia With Combination of Non-Ablative Laser Therapy and Topical Antioxidants. *J. Drugs Dermatol. JDD* **2024**, *23* (9), 769–773. [CrossRef]
52. Rageh, M.; Ibrahim, S.M.A.; Abdallah, N.; Tawfik, A.A. Autologous nanofat injection combined with fractional CO_2 laser in the treatment of atrophic acne scars. *Clin. Cosmet. Investig. Dermatol.* **2024**, *17*, 697–705. [CrossRef] [PubMed]
53. Saedi, N.; Griffin, T., Jr.; Kelly, S. Treatment of Mild to Severe Acne Vulgaris with a 650-Microsecond 1064-nm Nd:YAG Laser. *J. Drugs Dermatol. JDD* **2024**, *23* (11), 957–964. [CrossRef]

54. Nathan, N.R.; Gomes, L.L.A.; Wang-Evers, M.; Manstein, D. Ablative fractional laser treatment for the clinical improvement of acne vulgaris: A case series. *J. Cosmet. Dermatol.* **2024**, *23* (8), 2531–2536. [CrossRef] [PubMed]
55. Ashmawy, S.S.; Kassem, E.M.; Gheida, S.F.; Ramzy, N.E. Efficacy of low-level laser versus topical erythromycin 2% in the treatment of inflammatory acne vulgaris. *Dermatol. Pract. Concept.* **2024**, *14* (2), e2024048. [CrossRef] [PubMed]
56. Lim, J.T.-E.; Mbbs, J.T.-E. Efficacy and safety of solid-state dual-wavelength lasers for the treatment of moderate-to-severe inflammatory acne in Asian populations. *Plast. Reconstr. Surg.–Glob. Open* **2024**, *12* (1), e5550. [CrossRef] [PubMed]