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ORIGINAL ARTICLE

Journal of Drugs in Dermatology

Practical Algorithm for Acne Treatment Integrating Skincare and Energy-Based Devices

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ABSTRACT

Background: Energy-based devices (EBDs) are increasingly used to manage acne and its sequelae. While literature supports the use of appropriate skin care for acne, few studies address how to effectively integrate skincare with EBDs.

Methods: Six dermatologists from North America, participated in a live meeting to develop an acne treatment algorithm integrating skincare and EBDs. Six additional advisors contributed through a pre-meeting survey (along with 94 other physicians). The eleven dermatologists (authors) from Asia, Europe, Australia, and North America participated in algorithm development and manuscript review.

Results: The proposed algorithm describes how to integrate skin care with the use of EBDs in clinical practice.

Conclusions: This algorithm provides an approach for managing acne and best practices for integrating skin care with EBDs when treating acne and acne sequelae.

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INTRODUCTION

Despite the growing use of energy-based devices (EBDs) in dermatology, there remains a lack of structured guidance for clinicians on combining EBDs with skin care in acne and post-acne sequelae management. Pre- and post-procedural skin care is particularly relevant when EBDs are used, as appropriate skin care may enhance treatment efficacy, minimize side effects, and improve patient adherence, especially in patients with acne and subsequent sequelae.[1-5] This paper presents a practical algorithm to support clinicians who use EBDs in delivering patient-centered care by integrating appropriate skin care with EBDs for acne and acne sequelae.

MATERIALS AND METHODS

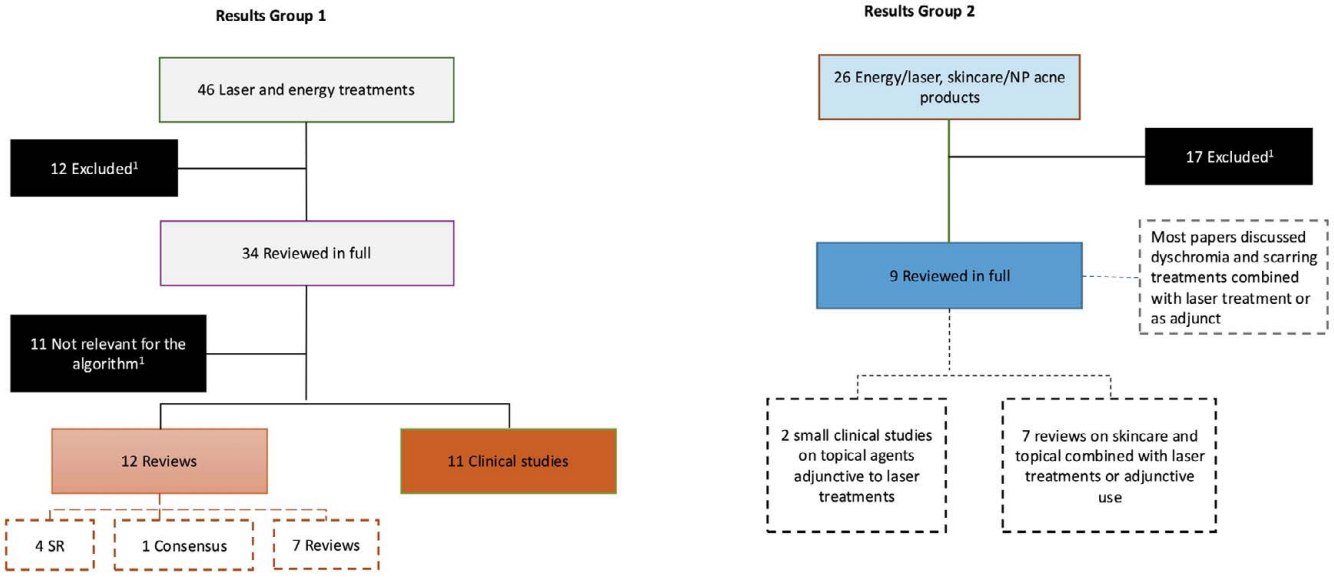
This project aimed to develop a practical algorithm to provide clinicians with skincare recommendations for acne treatment and maintenance with EBDs. This approach may prevent disease progression, treat acne-related sequelae, and improve patient outcomes.

Structured Literature Search

This project started with conducting a survey (N=100), selecting the expert panel, and conducting a structured literature review. The structured literature search looked for English-language studies, consensus papers, and other reviews of current best practices focusing on EBDs for acne treatment and maintenance with integrated skin care. Papers included were published between January 2010 to October 2024. Searches were limited to PubMed, with Google Scholar as a secondary source (Figure 1).

While published acne guidelines and algorithms provide information on prescription and non-prescription treatment, few acne guidelines include recommendations for EBDs.[6-8] The literature search found many publications on laser and light-based therapies for acne treatment but limited information on EBDs combined with skin care for acne patients.

FIGURE 1. Literature search results.



Clinical studies (CS); Randomized controlled trials (RCT); Retrospective studies (RS); Cross-sectional studies (CS); Systematic reviews (SR); Guidelines (GL); Meta-analysis (MA); Algorithm (Algo); Energy-based-devices (EBD)
[1]Excluded: Duplicates, not on EBDs, skin care, non-prescription acne products.
Due to a lack of clinical studies on EBDs and skin care, no grading was done.

The Panel

The panel comprised 12 advisors (authors). The advisors contributed virtually to the pre-meeting survey (along with additional physicians) for a total of 100 participants, and were actively involved in algorithm development and manuscript review. A draft algorithm was created based on the survey and literature search results.

Pre-Meeting Survey Results

This project incorporated a pre-meeting survey to assess physician behaviors regarding using EBDs in acne management and best practices for integrating skin care pre- and post-procedures.

Use of EBDs in Acne Management

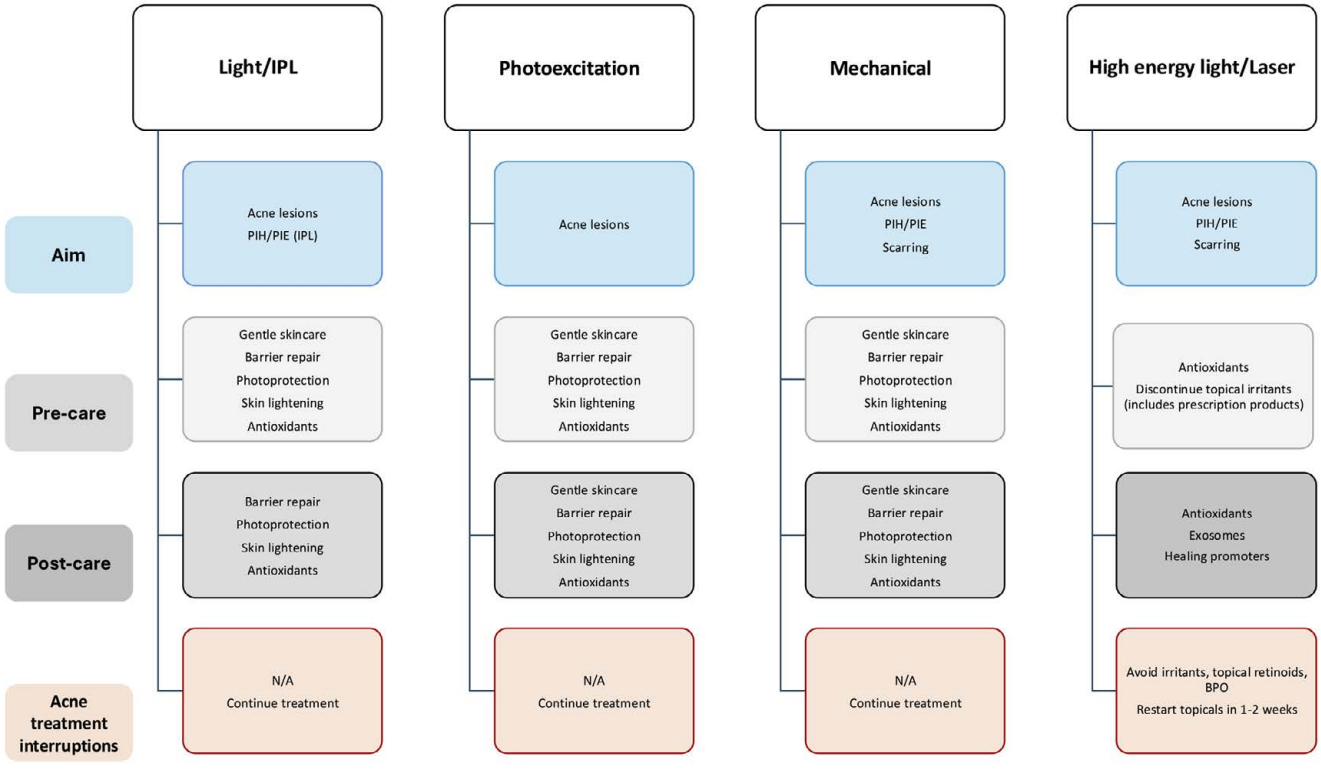
Pre-meeting survey results from advisors and the broader physician group support using EBDs to manage active acne and acne sequelae. Survey participants agreed that they most commonly recommend EBD treatment for patients with acne scars (88%), followed by patients who have acne-related dyschromia, such as PIH (78%), patients who have post-inflammatory erythema (PIE) from acne (78%), and patients with papules (43%), pustules (34%), and/or nodules (32%). Advisors rated the importance of EBDs and skincare treatment for patients with acne in clinical practice on a 5-point Likert scale (1 unimportant, 2 somewhat important, 3 neither unimportant or important, 4 important, 5 very important) as an average of 3.5.

TABLE 1.

Pre-Procedure and Post-Procedure Care Recommended by the Panel

Time of Care	Survey Question	Recommendation (% of advisors) N=100
Pre-procedure care	Most commonly recommended topical ingredients *pre-procedure* of applying an EBD to treat acne	Topical retinoids (51%) Topical antioxidants (42%) Topical BPO (42%)
	Most commonly recommended skincare products *pre-procedure* of applying an EBD to treat acne	Basic cleanser (79%) Moisturizer (53%)
Post-procedure care	Topical ingredients most commonly recommended *post-procedure* after using an EBD to treat acne	Topical antioxidants (55%) Retinoids (46%)
	Most commonly restricted topicals *post-procedure* when using an EBD to treat acne	Basic moisturizer (77%) Basic cleanser (72%)
	Most commonly restricted topicals *post-procedure* when using an EBD to treat acne	Topical retinoids (72%) Salicylic acid (62%) BPO (54%)

FIGURE 2. Energy-based devices and periprocedural skincare for treating active acne and acne sequelae.



IPL, intense pulsed light; PIE, post-inflammatory erythema; PIH, post-inflammatory hyperpigmentation; BPO, benzoyl peroxide.

Pre-Procedure and Post-Procedure Care

Advisors completed a pre-meeting survey describing their skincare recommendations for applying an EBD to treat acne both pre- and post-procedure (Table 1).

RESULTS

The Algorithm

The advisors agreed on an algorithm for integrating skin care with EBDs for acne treatment (Figure 2). This algorithm is limited to treating acne and its sequelae; it does not address the treatment of melasma.

Integrative Approach for Treating Active Acne and Acne Sequelae

An integrative approach for acne treatment is necessary as acne lesions and acne-related scars often coexist in clinical practice. Research highlights the psychosocial impact of acne scarring, including its effects on self-perception, social functioning, and management strategies.[9,10] This underscores why EBDs are being actively adopted in clinical practice. Timely management of acne lesions is crucial to prevent additional sequelae (like post-acne erythema and pigmentation), necessitating effective and targeted interventions to control the acne burden.[11,12]

Due to the complexity of acne pathogenesis, conventional treatments alone may not fully address all clinical aspects of acne. Therefore, EBDs are increasingly being explored as complementary solutions. EBDs represent one modality to treat acne and may offer the greatest benefit when used with prescription treatments.[9]

TABLE 2.

International Acne Guidelines Focused on Prescription Acne Treatment		
Journal	**Year**	**Title**
Journal of the American Academy of Dermatology	2024	Guidelines of care for the management of acne vulgaris
Journal of the European Academy of Dermatology and Venereology	2016	Guideline for the Treatment of Acne (Update 2016)
Canadian Medical Association Journal	2016	Management of acne: Canadian clinical practice guideline

TABLE 3.

Used for Acne			
Light/IPL	**Photoexcitation**	**Mechanical**	**High-Energy Light/Laser**
These devices use broadband light to target *C. acnes* and inflammation	Photodynamic therapy (PDT) involves activation of a photosensitizing agent like ALA or MAL by light to produce a therapeutic effect.	These devices physically disrupt inflammatory acne lesions (papules, pustules, nodules, cysts) and non-inflammatory acne lesions (comedones), as well as acne scarring (atrophic scars, hypertrophic scars/keloids, PIE/PIH).	These devices use coherent, monochromatic light sources that dliver high energy, focused light to specific skin targets.
Examples: • Blue light • Red light • IPL	Examples: • ALA-PDT with blue or red light • ALA + PDL • Gold nanoparticle-mediated photothermal therapy (AuNP-PTT)	Examples: • Microdermabrasion • Microneedling • Radiofrequency	Examples: • 1728 Laser • PDL • Nd:YAG Laser • Diode lasers • Fractional lasers (Ablative and non-ablative)

IPL, intense pulsed light; ALA, aminolevulinic acid; MAL, methyl aminolevulinate; PIE, post-inflammatory erythema; PIH, post-inflammatory hyperpigmentation; PDL, pulsed dye laser; Nd:YAG, neodymium-doped yttrium aluminum garnet.

Published acne guidelines and consensus papers (Table 2) provide further details on prescription acne treatment.[6-8] This paper will focus on EBDs and integrating topical skin care with EBD therapies for acne.

Energy-Based Devices

EBDs can be classified into different categories (Table 3) with varying modes of action and side effects.[13-15] Depending on the EBD, they can be used to treat active acne, acne-related dyschromia, and/or acne-related scarring.

Laser and light-based therapies are increasingly recognized as effective and safe treatment options for acne and its sequelae.[14] In clinical trials, the 1726 nm laser demonstrated substantial potential as an effective and well-tolerated therapeutic option for treating mild-to-severe acne.[16,17] In a prospective, open-label, single-arm study of 104 participants with moderate-to-severe facial acne who received 3 laser treatments at 3 (-1/+2)-week intervals, treatment with the 1726 nm laser was well-tolerated with durable progressive post-treatment improvement to at least 26 weeks for moderate-to-severe acne across skin types.[17] Clinical trials have also demonstrated significant improvement in inflammatory acne with modalities like intense pulsed light (IPL), blue-red LED combinations, and photodynamic therapy (PDT).[13] These therapies are effective across a spectrum of acne presentations, including papular, pustular, and comedonal acne, and they show promise as standalone or adjunctive treatments in cases where traditional therapies are less effective, such as in severe acne.[14]

Among light devices, PDT is the most studied, although it has post-operative downtime and expected side effects that include erythema, crusting, pain, and peeling over 7 to 14 days. It has demonstrated superior efficacy compared with some conventional topical and oral acne therapies, including topical adapalene and systemic doxycycline. IPL has also been extensively studied and has demonstrated favorable outcomes.[18] Nevertheless, the variability in study design, device settings, and treatment regimens limits the generalization of findings.

It is important to note that there are no head-to-head prospective trials comparing the efficacy of EBDs to prescriptions. Furthermore, the quality of EBD studies for acne is limited, with most, if not all, studies lacking an adequate control. Many existing studies are also non-randomized and industry-sponsored, underscoring the need for more rigorous, controlled trials to provide improved guidance on applying these modalities.[18,19]

Advantages of laser- and light-based treatments include reduced risk of antibiotic resistance, improved patient adherence, and improvement in skin quality and texture with minimal systemic side effects. However, multiple sessions are often required, which may present a cost barrier for some patients, and treatment results are variable. Treatments are also often painful and associated with downtime. Thorough patient counseling and informed consent are essential.[18]

Traditionally, clinicians treated active acne before addressing sequelae; however, the panel recommends a more proactive approach of treating both simultaneously when appropriate. Early intervention with EBDs may reduce long-term sequelae and improve overall outcomes. Combination therapy with prescription medications and EBDs may also be optimal for certain populations. For example, patients with nodulocystic and severe acne who are on, or have recently completed, isotretinoin are likely to be among those who would benefit from intervention with EBD to treat dyschromia and mitigate scarring.[9]

TABLE 4.

Key Components of a Skincare Regimen in Patients With Acne	
Skincare	**Considerations**
Cleanser	• Non-comedogenic
Antioxidants	• Vitamin C (ascorbic acid) and vitamin E, omega 3 fatty acids, polyphenols
Moisturizer	• Gentle, lipid-enhanced, with physiologic pH (<6.5) • Non-¬comedogenic
Photoprotection	• Broad-spectrum SPF 50+

SPF, sun protection factor.

Skin Care

Appropriate skin care (Table 4) plays an essential role in managing acne and preventing acne-related sequelae, such as dyschromia and scarring. A gentle cleanser and moisturizer, sunscreen, and antioxidants are key components of a skincare regimen that should be used regularly in individuals with acne.[1,2,20]

Moisturizers can reduce skin irritation by improving stratum corneum hydration and restoring skin barrier function. In those with acne, it is important to select non-comedogenic moisturizers.[1,2]

Research shows a link between sebum oxidation and the formation of blemishes.[3] Blemish-prone skin has higher levels

TABLE 5.

Evidence to Support the Use of Topical Antioxidants and AHA/BHA in Patients With Acne			
Agent	**Article Title**	**Key Findings**	**References**
Antioxidant	A silymarin antioxidant serum improves facial acne alone and as part of a treatment regimen	Silymarin is shown in clinical testing to have significant benefits in reducing lipid peroxidation, oiliness, and PIH, and in improving key markers of skin aging. Additionally, the serum can be used alone or as adjunctive treatment in acne therapy to further benefit aging, acne-prone skin.	Draelos Z, et al. JDD, 2024.
Antioxidant	Efficacy and safety of silymarin containing antioxidant serum as an adjuvant treatment of mild-to-moderate acne vulgaris: A prospective, open-label pilot study	The 0.5% Silymarin-containing antioxidant formulation improved acne's clinical severity and related skin biophysical parameters.	Kim J, et al. JCD, 2022.
Antioxidant	Treatment of Acne Vulgaris-Associated Post-Inflammatory Dyschromia With Combination of Non-Ablative Laser Therapy and Topical Antioxidants	A statistically significant decrease in PIH and intralesional melanin was seen in patients treated with a combination silymarin/salicylic acid/L-ascorbic acid/ferulic acid (SSAF) and non-ablative laser therapy. Improvement of both PIE and PIH was augmented in combination with SSAF and laser-treated patients versus the laser-only group.	Hu J, et al. JDD, 2024.
Antioxidant	Epigallocatechin-3-gallate improves acne in humans by modulating intracellular molecular targets and inhibiting *P. acnes*	EGCG, the major polyphenol in green tea, reduced sebum, reduced inflammation, and significantly improved acne in an 8-week randomized, split-face, clinical trial.	Yoon JY, et al. JID, 2013.
AHA/BHA	Safety and efficacy of two anti-acne/anti-aging treatments in subjects with photodamaged skin and mild to moderate acne vulgaris	The combination salicylic acid, capryloyl salicylic acid, HEPES, glycolic acid, citric acid, and dioic acid product is an effective treatment for improving skin tone, reducing blemishes, and addressing signs of aging and acne. It performs comparably to 0.025% tretinoin, providing superior improvements in skin tone evenness, clarity, and blemish reduction. Early improvements are noticeable. Both treatments show similar results in reducing fine lines, clogged pores, roughness, and dullness.	Kircik L, et al. JDD, 2012.
AHA/BHA	Efficacy and safety of a facial serum and mask containing salicylic acid and lipohydroxy acid in acne management: A randomized controlled trial	The study serum improved skin conditions by regulating skin barrier function and achieving a balance of skin hydration and sebum secretion, removing comedones, and improving PIE and PIH. Addition of the mask accelerated the effects without compromising safety.	Li S, et al. JCD, 2023.
AHA/BHA	Clinical evaluation of the efficacy of a facial serum containing dioic acid, glycolic acid, salicylic acid, LHA, citric acid, and HEPES in treating post-inflammatory hyperchromia and controlling oily skin in patients with acne vulgaris	The daily treatment using the investigational product showed an interesting decrease both in the grade and the number of post-inflammatory hyperchromia acne lesions after 56 days, and in the oiliness after 7 days, remaining stable through the study period.	Campos V, et al. JCD, 2021.

PIH, post-inflammatory hyperpigmentation; PIE, post-inflammatory erythema; EGCG, epigallocatechin gallate; HEPES, N-2-hydroxyethylpiperazine-N'-2-ethanesulfonic acid; LHA, lipohydroxy acid.

of sebum and lower levels of antioxidants, making it more vulnerable to lipid oxidation and blemish formation.[21,22] Lipid peroxidation alters the composition of sebum and creates an environment that supports the overgrowth of *C. acnes*, triggering an inflammatory response and leading to breakouts.[23]

Evidence supports using topical antioxidants in the treatment of acne (Table 5).[3,24-30] Antioxidants protect against lipid peroxidation.[22] A 12-week study examining the role of a silymarin antioxidant serum alone and in combination with a prescription acne treatment regimen in improving facial appearance in blemish-prone skin demonstrated a 45% reduction in inflammatory lesions and a 43% reduction in noninflammatory lesions after 12 weeks of silymarin antioxidant serum use.[3] Thus, incorporating topical antioxidants into a skincare routine for acne-prone skin may help improve patient outcomes.

Furthermore, since ultraviolet light (UV) exposure can worsen acne and induce PIE/PIH, sunscreen is essential to protect the skin.[20] Advisors recommend that patients be advised to use non-comedogenic sunscreen.

Periprocedural Care for EBDs

Skincare regimens may need to be adjusted before and after treatment with EBDs. Pre- and post-procedural care vary depending on the device and procedure (Figure 2). The panel described best practices for adjusting skin care according to the type of EBD, as outlined below.

Pre-procedure skin care

Prior to EBD procedures, moisturizers help hydrate the stratum corneum and enhance barrier function—a crucial property for patients with acne, whose skin may be compromised by topical or systemic acne treatments. A healthy skin barrier may reduce the risk of excessive irritation during treatment.[2]

Antioxidants also play an important role pre-procedure. Studies have shown that EBD treatment may be combined with pre-procedure topical antioxidants to optimize treatment outcomes.[1]

Post-procedure skin care

Post-procedure care depends on the laser and the timeframe. Patients should be counseled to continue using gentle skin care and adequate sunscreen (SPF >50) post-procedure.[1]

Moisturizers support recovery by promoting barrier repair, reducing transepidermal water loss, and soothing post-procedural discomfort, such as dryness, tightness, or flaking. Choosing non-comedogenic, fragrance-free formulations with ingredients like ceramides or hyaluronic acid may further help prevent post-treatment irritation.[2]

Antioxidants are also a beneficial component of post-procedure skin care. In a double-blind, randomized split-face trial of antioxidants (Vitamin C, E, and Ferulic acid) to decrease post-procedure recovery time in fractional ablative laser resurfacing, antioxidant use correlated with more rapid wound healing and was well-tolerated.[1,31]

Photoprotection with sunscreen is also essential following EBD procedures. Sunscreen protects sensitive skin from UV radiation and reduces the risk of PIH following the procedure.[2] Sunscreen may also shorten recovery time following EBD procedures.[20]

The panel agreed that acne treatment interruptions are unnecessary for patients undergoing treatment with light/IPL, photoexcitation, or mechanical procedures. However, individuals undergoing high-energy light/laser procedures should be advised to avoid irritants, topical retinoids, and benzoyl peroxide immediately prior to the procedure. In these cases, the panel suggested that topical retinoids and prescription treatments can be restarted 1 to 2 weeks after the high-energy light/laser procedure.

DISCUSSION

Integrating periprocedural skin care for EBDs can enhance treatment outcomes, improve patient experience, and reduce downtime. Moisturizers are critical during both the pre- and post-procedural phases when using EBDs for treating acne. Maintaining optimal skin hydration is essential for protecting the skin barrier, reducing the risk of irritation, and supporting effective healing.[2]

Topical antioxidants play an important role in acne by soothing inflammation and supporting skin barrier function.[22] Periprocedural use of antioxidants has been shown to promote tissue healing.[1]

Photoprotection should be incorporated into acne treatment. Broad-spectrum sunscreens protect from UV radiation and can provide stratum corneum hydration, enhance the skin barrier function, and reduce transepidermal water loss.[20] Post-procedure use of sunscreen may also shorten recovery time and reduce post-laser PIH.[1]

Limitations

The pre-meeting survey focused on office-based devices and did not capture information on over-the-counter devices. Additionally, sunscreen was not explicitly included in the skincare-related survey questions, despite being a key component of skin care in those with acne. The algorithm presented reflects expert consensus informed by current literature. While alternative approaches exist, the algorithm and recommendations represent best practices developed by a panel of expert clinicians and supported by evidence in the literature.

CONCLUSION

The algorithm presents an integrative approach for treating acne and its sequelae, with concurrent use of prescription acne treatments, skin care, and EBDs for optimal patient outcomes. When undergoing procedures with EBDs, periprocedural skin care with gentle cleansers, moisturizers, photoprotection, and antioxidants may improve treatment outcomes and maximize procedural tolerability. The panel provided best practices for integrating skin care with EBD procedures for acne.

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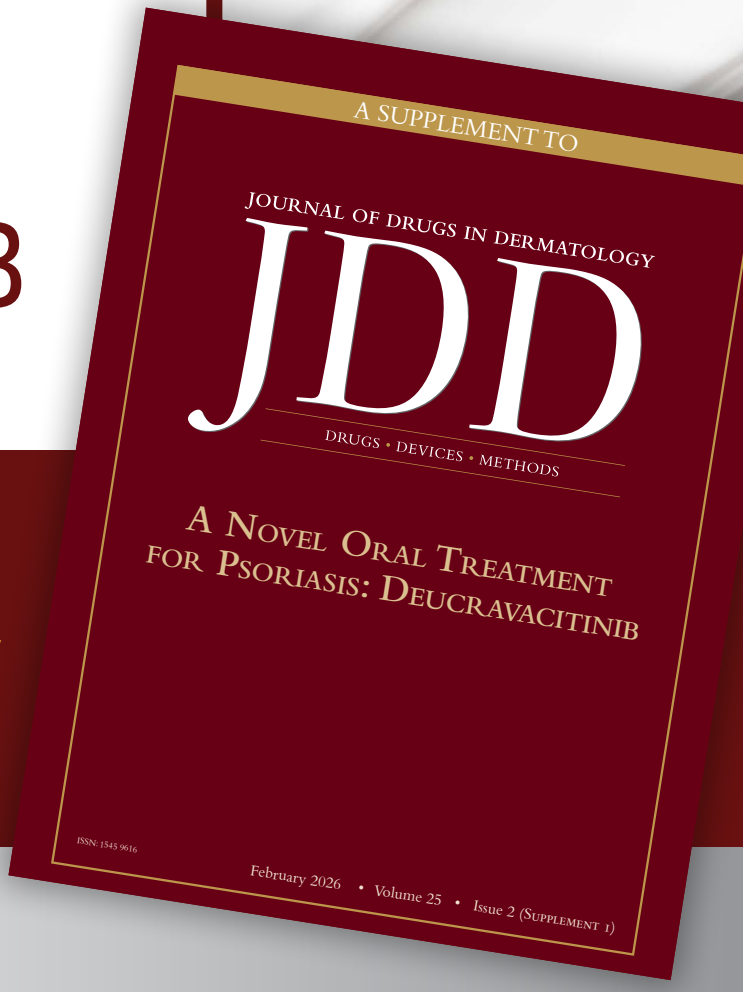

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ORIGINAL ARTICLE

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Efficacy and Safety of Clascoterone Cream 1% for Acne Are Independent of Age and Sex

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ABSTRACT

Acne vulgaris is an inflammatory skin condition affecting adolescents and adults of both sexes. Clascoterone cream 1% is indicated for the topical treatment of acne vulgaris in patients ≥12 years of age based on the results of two Phase 3 trials (NCT02608450 and NCT02608476). This post hoc analysis evaluated the efficacy and safety of clascoterone cream 1% in patient subgroups defined by age (adolescent vs adult) and sex (male vs female). Patients ≥12 years of age with mild-to-moderate acne applied clascoterone cream 1% or vehicle twice daily for 12 weeks. Efficacy was assessed from Investigator's Global Assessment (IGA) treatment success and inflammatory, noninflammatory, and total lesion counts, and safety from frequency and severity of adverse events. Treatment with clascoterone cream 1% vs vehicle resulted in significantly greater IGA treatment success rates for all subgroups: at week 12, 47/287 (16.4%) vs 12/306 (3.9%) adolescent, 77/330 (23.3%) vs 29/309 (9.4%) adult, 32/226 (14.2%) vs 13/252 (5.2%) male, and 92/391 (23.5%) vs 28/363 (7.7%) female patients achieved IGA treatment success. Patients treated with clascoterone cream 1% vs vehicle in all subgroups also experienced significantly greater lesion count reductions. From baseline to week 12, clascoterone cream 1% treatment resulted in significantly larger reductions in lesion counts in adult vs adolescent patients; there were no statistically significant differences between male and female patients. Adverse events were similar across subgroups. These results further support the efficacy and tolerability of clascoterone cream 1% across the spectrum of patients ≥12 years of age with acne vulgaris.

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INTRODUCTION

Acne vulgaris is an inflammatory skin condition that affects 9.4% of the global population.[1] Acne is most common during adolescence but can also develop or persist into adulthood.[2] Both sexes are affected, although more women than men seek treatment for and are diagnosed with acne in adulthood.[3]

Acne pathogenesis is largely androgen driven. Testosterone and dihydrotestosterone regulate sebum production by binding to the androgen receptor in the sebaceous gland.[4,5] This sebum and excess keratinous material stimulate bacteria to colonize in pores, forming noninflammatory (closed or open comedones) and inflammatory (papules, pustules, nodules, and cysts) lesions.[6] Although the involvement of androgens explains the high incidence of acne in adolescents at the onset of puberty, acne pathogenesis is androgen driven regardless of age and sex.

Recommended treatments for acne include topical therapies (retinoids, antibiotics, benzoyl peroxide, salicylic acid, azelaic acid, and clascoterone), systemic antibiotics (doxycycline, minocycline, and sarecycline), hormonal agents (combined oral contraceptives [COCs], spironolactone, and intralesional corticosteroids), and isotretinoin[7]; however, some systemic treatments are not appropriate for all patients based on age and/or sex considerations.[7,8]

Clascoterone cream 1% is a first-in-class androgen receptor inhibitor indicated for the topical treatment of acne vulgaris in patients 12 years of age and older.[9,10] While the mechanism of action of clascoterone cream 1% for acne treatment is not known,[10] in vitro, clascoterone cream 1% is an androgen receptor antagonist that inhibits both lipogenic and pro-inflammatory signaling necessary for acne pathogenesis.[11,12] In two Phase 3 clinical trials, treatment with clascoterone cream 1% for 12 weeks demonstrated greater efficacy compared with vehicle cream for reducing acne severity and lesion counts in patients ≥9 years of age with moderate-to-severe facial acne, with a favorable safety profile during 9 months of treatment in an open-label extension study.[13,14] This post hoc pooled data analysis of the Phase 3 clinical trials was performed to evaluate the efficacy and safety of clascoterone cream 1% in patient subgroups defined by age (adolescent vs adult) and sex (male vs female).

MATERIALS AND METHODS

Study Design

The multicenter, randomized, double-blind, vehicle-controlled, parallel-group, Phase 3 trials (NCT02608450 and NCT02608476) evaluated the efficacy and safety of topical clascoterone cream 1% in patients with acne vulgaris.[13] Study approval was obtained for all study sites from the appropriate ethics committees, institutional review boards, and national central authorities, and protocols were approved by the US Food and Drug Administration (FDA). The studies were conducted according to the Declaration of Helsinki. Patients and/or parents or guardians provided informed consent/assent.

Patients

The Phase 3 studies enrolled male and nonpregnant female patients ≥9 years of age with moderate-to-severe facial acne vulgaris, defined as Grade 3 or 4 on the Investigator's Global Assessment (IGA) scale with 30 to 75 total inflammatory lesions and 30 to 100 total noninflammatory lesions[13]; only the approved population, patients ≥12 years of age, were included in this post hoc analysis. Patients were required to be on a consistent skin care regimen for at least 1 month prior to enrollment and continue the program for the duration of the study.[13] Exclusion criteria were previously described and included (1) more than 2 facial nodules; (2) use of any topical antiacne treatments or systemic antiacne medications; and (3) participation in a prior clascoterone clinical trial.[13]

Treatments and Assessments

Enrolled patients were randomized 1:1 to receive clascoterone cream 1% or matching vehicle cream. Patients applied approximately 1 gram of clascoterone cream 1% or vehicle cream to their entire face twice daily for 12 weeks.[13] Efficacy assessments were performed at all study visits (screening/baseline, week 4, week 8, and week 12) and included IGA, inflammatory lesion count (ILC), and noninflammatory lesion count (NILC). The IGA was rated on a 5-point scale from 0 (clear) to 4 (severe); lesions were counted manually.[13] The efficacy outcomes were the percentage of patients with treatment success at week 12, defined as an IGA score of clear (0) or almost clear (1) with at least a 2-point reduction compared to baseline (coprimary efficacy endpoint in the Phase 3 trials), and the absolute change from baseline in ILC, NILC (coprimary efficacy endpoints in the Phase 3 trials), and total lesion count (TLC; secondary efficacy endpoint in the Phase 3 trials). Safety assessments included the frequency and severity of adverse events, as previously described.[13]

Statistical Analysis

Sample size calculations were previously reported.[13] Data from patients ≥12 years of age were pooled from the two Phase 3 trials. Efficacy was analyzed in the intention-to-treat set, which included all randomized patients. Safety was analyzed in all patients who received ≥1 application of the study drug.[13] IGA success rates were analyzed using logistic regression, with study ID, age, sex, race, ethnicity, and baseline IGA scores as fixed effects. Changes in lesion counts were analyzed using analysis of covariance, with study ID, age, sex, race, ethnicity, and baseline IGA scores as fixed effects. Missing data were not imputed.

RESULTS

Patient Demographics and Baseline Characteristics

The two Phase 3 studies enrolled 1421 patients ≥12 years of age, of whom 709 were randomized to clascoterone cream 1% and 712 to vehicle cream. Mean age was 19.8 years for patients treated with clascoterone cream 1% and 19.5 years for vehicle-treated patients, and the majority of patients were female (clascoterone cream 1%, 63.9%; vehicle cream, 60.4%), White (clascoterone cream 1%, 91.0%; vehicle cream, 90.3%), and entered the study with moderate acne (IGA score of 3; clascoterone cream 1%, 82.5%; vehicle cream, 84.1%). Lesion counts were comparable between treatment arms (Table 1).

In the subgroup analysis by age, 316 adolescent and 393 adult patients received clascoterone cream 1%, and 325 adolescent and 387 adult patients received vehicle. In the subgroup analysis by sex, 256 male and 453 female patients were randomized to clascoterone cream 1%, and 282 male and 430 female patients were randomized to vehicle. Baseline lesion counts were comparable between adolescent and adult patients and between male and female patients (Table 2).

Efficacy

IGA treatment success

Acne severity, as assessed by IGA score, improved from baseline across the subgroups of adolescent, adult, male, and female patients using clascoterone cream 1% compared with

TABLE 1.

Demographics and Baseline Clinical Characteristics		
Characteristics	**Clascoterone n = 709**	**Vehicle n = 712**
Sex, n (%)		
Male	256 (36.1)	282 (39.6)
Female	453 (63.9)	430 (60.4)
Age, years		
12 to 17, n (%)	316 (44.6)	325 (45.6)
≥18, n (%)	393 (55.4)	387 (54.4)
Mean ± SD	19.8 ± 6.1	19.5 ± 6.1
Race, n (%)		
Asian	8 (1.1)	14 (2.0)
Black or African American	37 (5.2)	40 (5.6)
Other[a]	19 (2.6)	15 (2.1)
White	645 (91.0)	643 (90.3)
IGA score, n (%)		
3 (moderate)	585 (82.5)	599 (84.1)
4 (severe)	124 (17.5)	113 (15.9)
Lesion counts, mean ± SD		
NILC	60.9 ± 21.8	61.9 ± 21.3
ILC	42.6 ± 12.0	42.1 ± 11.7
TLC	103.5 ± 25.4	104 ± 25.1

Phase 3 pooled ITT population ≥12 years of age.
[a]Includes patients who identified as American Indian or Alaska Native, multiple races, Native Hawaiian or Other Pacific Islander, and other race.
IGA, Investigator's Global Assessment; ILC, inflammatory lesion count; ITT, intention-to-treat; NILC, noninflammatory lesion count; SD, standard deviation; TLC, total lesion count.

vehicle-treated patients. Treatment with clascoterone cream 1% vs vehicle led to significantly higher IGA treatment success rates at week 12 in both adolescent (16.4% vs 3.9%; odds ratio [OR; 95% confidence interval (CI)], 4.70 [2.48, 8.91]; *P*<0.001) and adult (23.3% vs 9.4%; OR [95% CI], 3.06 [1.93, 4.85]; *P*<0.001) patients (Figure 1). Similarly, male and female patients treated with clascoterone cream 1% had significantly higher rates of IGA treatment success compared with vehicle-treated patients at week 12 (male patients: 14.2% vs 5.2%; OR [95% CI], 2.99 [1.55, 5.77]; *P*=0.001; female patients: 23.5% vs 7.7%; OR [95% CI], 3.76 [2.40, 5.90]; *P*<0.001; Figure 1). Within the clascoterone cream 1% treatment arm, there were no statistically significant differences in week 12 IGA success rates between adolescent and adult patients (OR [95% CI], 0.77 [0.50, 1.17]; *P*>0.05; Figure 1) or between male and female patients (OR [95% CI], 0.63 [0.40, 1.00]; *P*>0.05; Figure 1).

Lesion counts

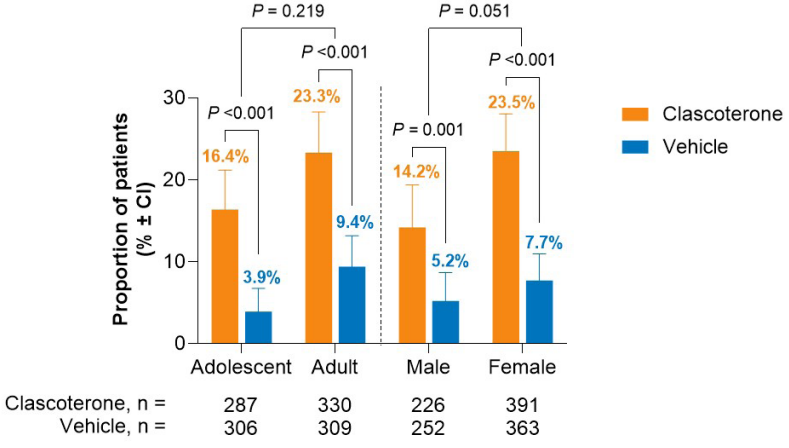
The ILC (Figure 2A), NILC (Figure 2B), and TLC (Figure 2C) decreased from baseline to week 12 across all subgroups of patients using clascoterone cream 1%. For adolescent patients treated with clascoterone cream 1%, the least square mean (LSM) difference (95% CI) compared with vehicle-treated patients was –6.11 (–8.93, –3.30; *P*<0.001) for ILC, –11.30 (–16.20, –6.39; *P*<0.001) for NILC, and –14.07 (–20.54, –7.59; *P*<0.001) for TLC. When comparing adult patients using clascoterone cream 1% with those using vehicle cream, LSM differences (95% CI) for ILC, NILC, and TLC were –6.88 (–9.17, –4.60; *P*<0.001), –9.30 (–13.03, –5.58; *P*<0.001), and –18.02 (–23.48, –12.55; *P*<0.001), respectively. The LSM difference (95% CI) for male patients treated with clascoterone cream 1% vs vehicle was –8.36 (–11.47, –5.26; *P*<0.001) for ILC, –11.00 (–16.00, –6.00; *P*<0.001) for NILC, and –18.11 (–25.17, –11.05; *P*<0.001) for TLC. Finally, for female patients treated with clascoterone cream 1%, the LSM difference (95% CI) vs vehicle for ILC was –6.12 (–8.33, –3.91; *P*<0.001), for NILC was –9.63 (–13.50, –5.76; *P*<0.001), and for TLC was –15.50 (–20.92, –10.08; *P*<0.001). Relative to adolescent patients, adults using clascoterone cream 1% had significantly larger mean reductions from baseline in ILC (LSM difference [95% CI], 3.62 [1.05, 6.19]; *P*=0.006; Figure 2A), NILC (LSM difference [95% CI], 9.06 [4.50, 13.62]; *P*<0.001; Figure 2B), and TLC (LSM difference [95% CI], 13.40 [7.16, 19.64]; *P*<0.001; Figure 2C) at week 12. No statistically significant differences in lesion count reductions from baseline at week 12 were observed between male and female patients using clascoterone cream 1% (ILC: LSM difference [95% CI], 0.85 [–1.85, 3.54]; *P*=0.537; Figure 2A; NILC: LSM difference [95% CI], 1.19 [–3.42, 5.80]; *P*=0.613; Figure 2B; TLC: LSM difference [95% CI], 5.15 [–1.28, 11.59]; *P*=0.116; Figure 2C).

TABLE 2.

Baseline Lesion Counts by Age and Sex								
Lesion Counts	**Adolescent**		**Adult**		**Male**		**Female**	
	Clascoterone n = 316	**Vehicle n = 325**	**Clascoterone n = 393**	**Vehicle n = 387**	**Clascoterone n = 256**	**Vehicle n = 282**	**Clascoterone n = 453**	**Vehicle n = 430**
NILC	65.2 ± 22.6	66.4 ± 20.8	57.4 ± 20.5	58.2 ± 21.0	61.1 ± 22.7	61.9 ± 21.0	60.7 ± 21.3	62.0 ± 21.5
ILC	42.8 ± 12.1	42.6 ± 11.6	42.5 ± 11.9	41.7 ± 11.7	44.2 ± 12.1	43.8 ± 11.7	41.7 ± 11.8	41.0 ± 11.5
TLC	108.0 ± 26.1	108.9 ± 24.6	99.9 ± 24.2	99.9 ± 24.7	105.3 ± 26.7	105.7 ± 24.3	102.5 ± 24.6	103.0 ± 25.5

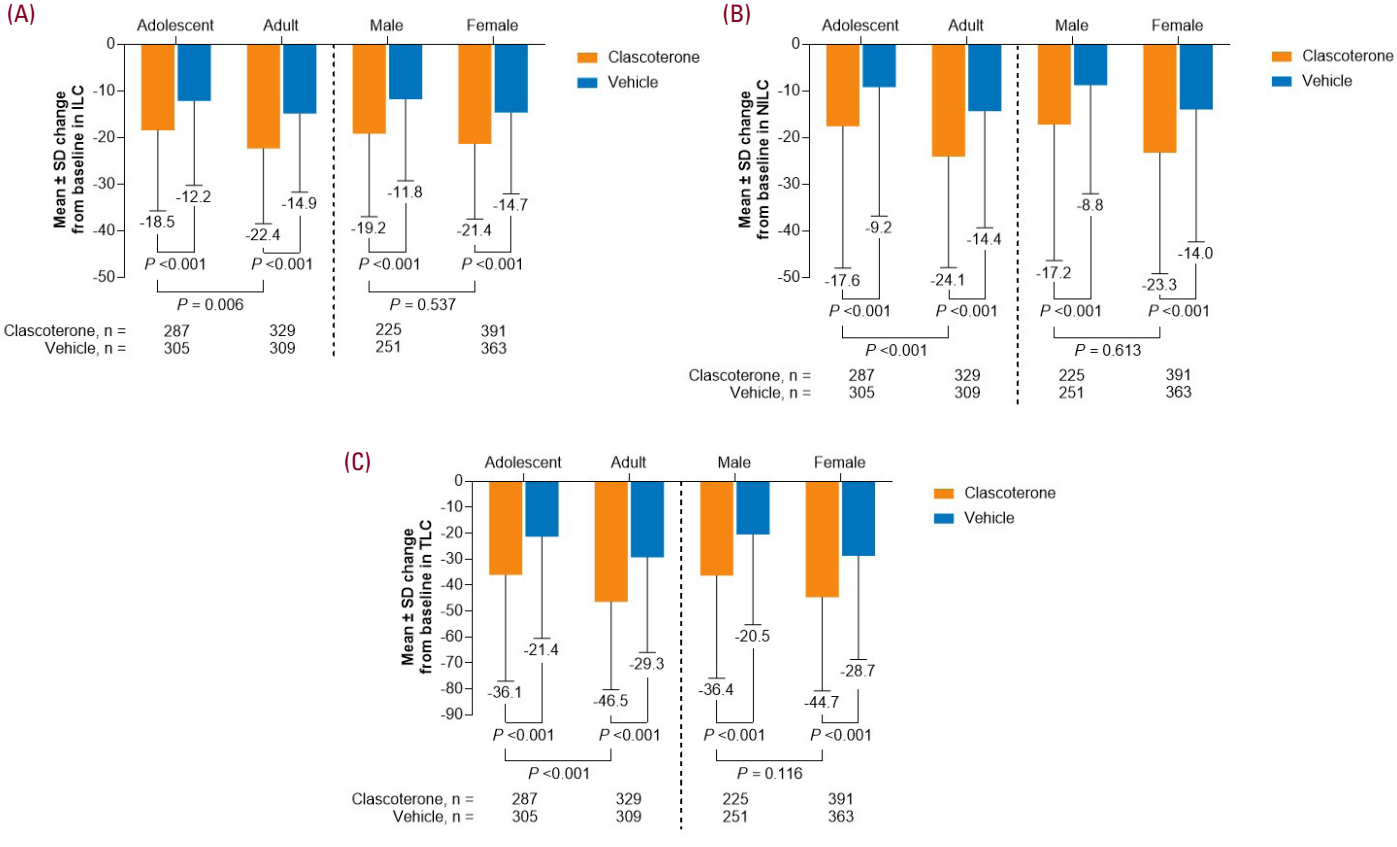
Data are shown as mean ± SD.
ILC, inflammatory lesion count; NILC, noninflammatory lesion count; SD, standard deviation; TLC, total lesion count.

FIGURE 1. Proportions of adolescent, adult, male, and female patients achieving IGA treatment success at week 12 in the Phase 3 clinical studies.



IGA success rates are presented at week 12 for the ITT population of patients ≥12 years of age. IGA success was defined as an IGA score of clear (0) or almost clear (1) and at least a 2-point reduction in IGA score compared to baseline.
CI, confidence interval; IGA, Investigator's Global Assessment; ITT, intention-to-treat.

FIGURE 2. Mean absolute change from baseline at week 12 stratified by age and sex in (A) inflammatory, (B) noninflammatory, and (C) total lesion counts.



The absolute changes from baseline in ILC, NILC, and TLC were evaluated at weeks 4, 8, and 12. Changes in ILC, NILC, and TLC at week 12 are presented.
ILC, inflammatory lesion count; NILC, noninflammatory lesion count; SD, standard deviation; TLC, total lesion count.

TABLE 3.

Summary of Treatment-Emergent Adverse Event by Age and Sex Through Week 12 of the Phase 3 Clinical Trials

Category, n (%)	Adolescent		Adult		Male		Female	
	Clascoterone n = 316	Vehicle n = 325	Clascoterone n = 393	Vehicle n = 387	Clascoterone n = 256	Vehicle n = 282	Clascoterone n = 453	Vehicle n = 430
Any TEAE	34 (10.8)	46 (14.2)	45 (11.5)	45 (11.6)	25 (9.8)	30 (10.6)	54 (11.9)	61 (14.2)
TEAE Severity								
Mild	26 (8.2)	35 (10.8)	38 (9.7)	28 (7.2)	20 (7.8)	22 (7.8)	44 (9.7)	41 (9.5)
Moderate	11 (3.5)	15 (4.6)	8 (2.0)	17 (4.4)	7 (2.7)	10 (3.5)	12 (2.6)	22 (5.1)
Severe	0	2 (0.6)	0	1 (0.3)	0	1 (0.4)	0	2 (0.5)
Treatment-Related TEAEs	5 (1.6)	6 (1.8)	7 (1.8)	16 (4.1)	4 (1.6)	6 (2.1)	8 (1.8)	16 (3.7)
Serious TEAEs	0	1 (0.3)	0	1 (0.3)	0	1 (0.4)	0	1 (0.2)

Safety and tolerability were assessed by monitoring TEAEs through week 12 of the study.
TEAE, treatment-emergent adverse event.

Safety

The frequency of treatment-emergent adverse events (TEAEs) was similar across subgroups and treatment arms (Table 3). Among patients treated with clascoterone cream 1% vs vehicle, TEAEs were observed in 10.8% vs 14.2% of adolescent patients, 11.5% vs 11.6% of adult patients, 9.8% vs 10.6% of male patients, and 11.9% vs 14.2% of female patients. The majority of TEAEs within both age and sex subgroups were mild or moderate in severity, and the frequency of TEAEs considered related to the study drug was similar across subgroups and treatment arms. No serious TEAEs were reported in patients treated with clascoterone cream 1% (Table 3). TEAEs leading to study discontinuation occurred in 2 (0.6%) and 5 (1.5%) adolescent patients, 3 (0.8%) and 9 (2.3%) adult patients, 2 (0.8%) and 5 (1.8%) male patients, and 3 (0.7%) and 9 (2.1%) female patients using clascoterone cream 1% and vehicle, respectively. The most common TEAEs among all subgroups were nasopharyngitis, oropharyngeal pain, and headache. No deaths were reported.

DISCUSSION

In this post hoc analysis of the Phase 3 clinical trials, the efficacy and safety of clascoterone cream 1% were evaluated in subgroups of patients defined by age (adolescent vs adult) and sex (male vs female). The efficacy of clascoterone cream 1% vs vehicle, based on improvements from baseline in IGA score and lesion counts at week 12 previously observed in the overall population,[13] was maintained regardless of patient age or sex. The IGA treatment success rates at week 12 were not significantly different between adolescent and adult or male and female patients treated with clascoterone cream 1%. Reductions in lesion counts from baseline to week 12 were larger in adult vs adolescent patients but not significantly different between male and female patients. The safety profile of clascoterone cream 1% remained similar to that of vehicle cream for all patient subgroups, consistent with results from the Phase 3 studies,[13] and was comparable between adolescent vs adult and male vs female patients. This safety profile supports the use of clascoterone cream 1% in patients ≥12 years of age without further age or sex restrictions.

The efficacy of clascoterone cream 1% in acne reduction is attributed to its inhibition of androgen-induced sebum production.[11] Systemic hormonal therapies that target this pathway include oral isotretinoin, COCs, and spironolactone; however, all of these treatments have age- and/or sex-related considerations that limit their use.[7,8] Isotretinoin requires strict contraceptive use for patients of childbearing potential due to the possibility of fetal congenital malformations,[7] while spironolactone may have effects such as gynecomastia that may not be acceptable to male patients.[8] COCs are only FDA approved for female patients ≥14 to 15 years of age and are contraindicated in patients ≥35 years of age who smoke or have other pre-existing health conditions due to increased risks of myocardial infarction and stroke[7]; thus, their use is restricted in adult female patients who make up the majority of adults seeking acne treatment.[3] In contrast, results from this study support the safe and effective use of clascoterone cream 1% in both male and female patients ≥12 years of age.

Topical therapies are considered the mainstay of acne treatment, but age- and sex-related differences in efficacy are observed for some of these agents.[7] In one study, combination therapy with the retinoid adapalene and benzoyl peroxide was equally safe and effective for reducing acne severity and lesion counts in adolescent vs adult and male vs female patients,[15] similar to our findings. In contrast, in male and female patient subgroups divided into 3 age categories (13–19, 20–29, and ≥30 years of age), tazarotene 0.045% lotion was significantly more effective vs vehicle at reducing acne severity and lesion counts only for younger patients; male and female patients ≥30 years of age did not experience statistically significant improvements compared with vehicle-treated patients.[16] In contrast, in the current study, adults using clascoterone cream 1% experienced significantly larger reductions from baseline to week 12 in lesion counts relative to adolescent patients. This observed difference may be due to Type I error; alternatively, the greater efficacy of clascoterone cream 1% in adult patients compared with adolescents may be due to poor treatment adherence[17] and/or higher androgen levels[18] in adolescents.

Strengths and Limitations of the Analysis

This analysis' strengths include using data from a large, prospective, randomized, placebo-controlled study. One limitation is that combinations of age and sex (eg, male adolescent patients vs female adolescent patients) could not be studied due to the limited number of patients in some subgroups. Thus, interpretations were limited to data stratified by age regardless of sex and by sex regardless of age, and potential interactions between the 2 variables could not be evaluated.

CONCLUSION

In conclusion, clascoterone cream 1% was significantly more effective relative to vehicle for treating acne regardless of patient age or sex. No significant differences in efficacy were observed between male and female patients, but adult patients experienced significantly larger reductions from baseline in lesion counts relative to adolescent patients. The safety profile of clascoterone cream 1% through week 12 was similar among all subgroups. These results provide further evidence supporting the use of clascoterone cream 1% for the treatment of acne vulgaris in patients 12 years of age and older, regardless of age or sex.

DISCLOSURES

JL received an honorarium and consulting fees from Sun Pharma. LFE, AAH, and LSG were study investigators. AAH and LSG were also compensated advisors to Cassiopea S.p.A. LFE is an employee of the University of California San Diego, which received compensation from Cassiopea S.p.A., for study participation. He has also served as an investigator, advisor, or consultant for Almirall, Dermata, Galderma, Ortho Dermatologics, and Pfizer. AAH is an employee of the McGovern Medical School of The University of Texas Health Science Center in Houston, which received compensation from Cassiopea S.p.A., for study participation. She also received an honorarium for serving on the Cassiopea advisory board; all research grant funds were paid to her institution. She has also received personal fees for advisory, speaking, consulting, and/or other services with Almirall, Aslan, Galderma, Incyte, Novartis, Pfizer, and Sun Pharma. LSG is an employee of the Henry Ford Health System in Detroit, Michigan, which received compensation from Cassiopea S.p.A., for study participation; she has also received personal fees for advisory, speaking, consulting, research, and/or other services with Almirall, Foamix, Galderma, Novartis, Sol-Gel, and Sun Pharma. MC is employed as the vice president of medical affairs at Novan, was employed as the senior director of medical affairs at Cassiopea Inc., at the time of the study, received personal fees as a consultant from Cassiopea S.p.A., and receives personal fees as an adjunct faculty member from the University of Arizona. LM served as chief scientific officer of Cassiopea S.p.A. SS is an employee of Veranex. LL has received consulting fees from Arvelle Therapeutics, Celldex, Charite, Gamida Cell, Gossomer Bio, Halozyme Therapeutics, Kenjockety Biopharmaceuticals, mQOL, Noema Pharma, Regeneron Pharmaceuticals, Sun Pharma, UCARE, and the University of Berlin. DS was an employee of Sun Pharmaceutical Industries, Inc., at the time of study conduct. AM is employed as the chief medical officer for Cassiopea S.p.A., and has served as the chief medical officer of Cosmo Pharmaceuticals. NS and KK are employees of Sun Pharmaceutical Industries, Inc.

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ORIGINAL ARTICLE

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Real-World Evidence of Brodalumab Effectiveness for the Treatment of Psoriasis

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ABSTRACT

Brodalumab is a recombinant, fully human monoclonal antibody antagonist of the human interleukin-17 (IL-17) receptor A. It is indicated for the treatment of moderate-to-severe plaque psoriasis in adult patients who are candidates for systemic therapy or phototherapy and have failed to respond or have lost response to other systemic therapies. Brodalumab blocks signaling mediated by IL-17 cytokines, disrupting the inflammatory feedback loop between immune cells and keratinocytes that drives psoriasis, which may explain its efficacy in clinical trials. To explore its postapproval effectiveness, this review synthesizes real-world evidence of brodalumab across 14 international studies. Studies showed rapid onset of action and sustained effectiveness through extended follow-up periods. Notably, brodalumab achieved high response rates in patients whose psoriasis had failed to respond to prior IL-17A inhibitors. Comparative analyses position brodalumab favorably against other biologics, demonstrating its superior response rates and faster onset of action. Furthermore, brodalumab was efficacious in difficult-to-treat psoriasis manifestations, including nail psoriasis, generalized pustular psoriasis, and psoriatic erythroderma. Limitations of this report include variations in study designs, follow-up durations, and baseline characteristics across reviewed studies. The evidence collectively establishes brodalumab as a valuable therapeutic option, particularly for patients with treatment-resistant psoriasis and challenging subtypes.

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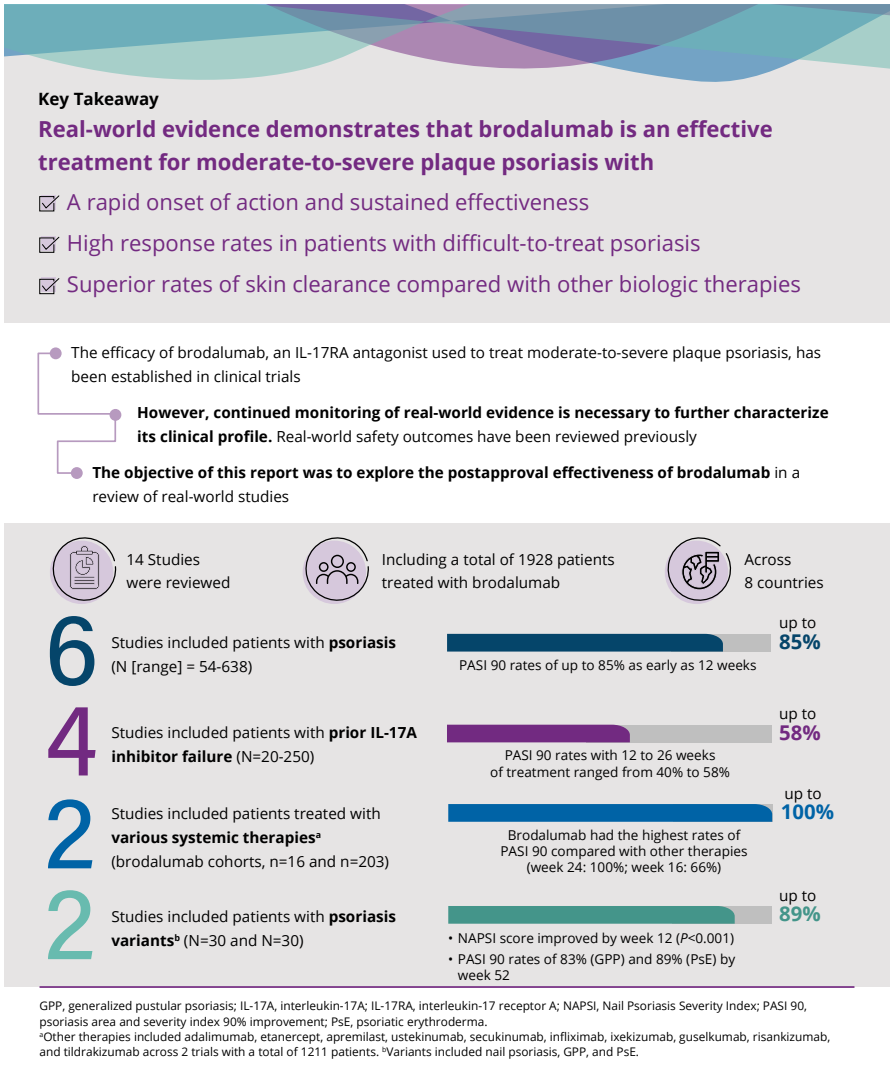
INTRODUCTION

Psoriasis is driven by proinflammatory cytokines, including interleukin (IL) 17, IL-23, and tumor necrosis factor alpha (TNF-α), resulting in keratinocyte hyperproliferation.[1] Several biologic therapies that treat moderate-to-severe psoriasis target TNF-α (etanercept, infliximab, adalimumab), IL-12/23 (ustekinumab), IL-17A (secukinumab, ixekizumab), and IL-23 (guselkumab, risankizumab).[2] Unique among biologic therapies, brodalumab is a human IL-17 receptor A (IL-17RA) antagonist indicated for the treatment of moderate-to-severe plaque psoriasis in adult patients who are candidates for systemic therapy or phototherapy and have failed to respond or have lost response to other systemic therapies.[3] Although the efficacy of brodalumab has been established in clinical trials, monitoring of real-world data is necessary to characterize its effectiveness. The objective of this review is to summarize real-world evidence of brodalumab, including nonsponsored open-label and real-world studies, to enhance the understanding of its effectiveness. A graphical summary of this review is shown in Figure 1.

Brodalumab: Mechanism of Action

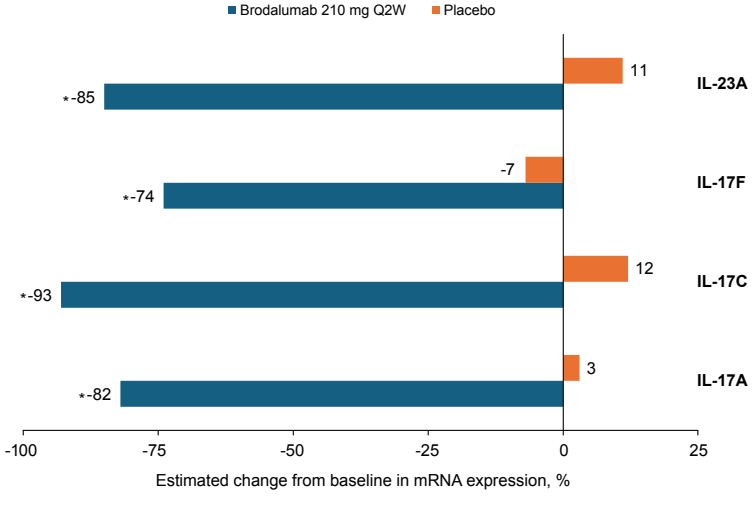
Brodalumab is a recombinant, fully human monoclonal antibody antagonist of human IL-17RA.[3] Brodalumab has a distinct mechanism of action (MOA) that blocks IL-17 signaling, disrupting the inflammatory feedback loop between immune cells and keratinocytes that contributes to psoriasis pathology.[4,5] In a biomarker analysis, by 12 weeks, brodalumab had significantly reduced the gene expression levels of multiple inflammatory proteins in psoriatic plaques compared with placebo (Figure 2).[6] Additionally, unlike the IL-17A inhibitor ixekizumab, brodalumab normalized psoriasis-associated genes in human skin cells typically activated by IL-17A, IL-17C, and IL-17F.[7] This downregulation of multiple inflammatory mediators demonstrates the broad effect of brodalumab on the immunopathology of psoriasis. The unique MOA of brodalumab may contribute to its rapid and sustained efficacy in phase 3 clinical trials (AMAGINE-1/-2/-3) and open-label extension studies,[8-12] and in patients with prior biologic therapy failure.[4,13]

FIGURE 1. Graphical summary.



GPP, generalized pustular psoriasis; IL-17A, interleukin-17A; IL-17RA, interleukin-17 receptor A; NAPSI, Nail Psoriasis Severity Index; PASI 90, psoriasis area and severity index 90% improvement; PsE, psoriatic erythroderma.
[a]Other therapies included adalimumab, etanercept, apremilast, ustekinumab, secukinumab, infliximab, ixekizumab, guselkumab, risankizumab, and tildrakizumab across 2 trials with a total of 1211 patients. [b]Variants included nail psoriasis, GPP, and PsE.

FIGURE 2. Estimated changes from baseline in mean gene expression of key biomarkers in psoriatic plaques after 12 weeks of treatment with brodalumab or placebo.[6]



IL, interleukin; Q2W, every 2 weeks. *P<0.001 vs placebo.

METHODOLOGY

We utilized studies previously identified for a real-world evidence review of brodalumab safety (Lebwohl et al, unpublished data, 2025) and extracted their effectiveness data. In the safety review, a PubMed search was conducted using the following search terms: "brodalumab psoriasis" (filtered for clinical trials), "brodalumab prospective," and "brodalumab retrospective." Publications were included if they reported primary research and were open-label or real-world evidence studies. References were excluded if they were randomized controlled trials or extensions of randomized trials, evaluated patient populations with disorders other than psoriasis, were reviews or meta-analyses, did not evaluate brodalumab-specific effectiveness outcomes, or were not published in English. Of the 18 real-world studies that were identified for the safety review, 4 were excluded because they lacked effectiveness outcomes. Thus, 14 studies met the inclusion criteria for this effectiveness review.

Postapproval Real-World and Open-Label Studies of Brodalumab

Brodalumab in patients with psoriasis

Six studies from the Czech Republic, Japan (2 studies), Italy, Greece, and Germany demonstrated the real-world effectiveness of brodalumab in patients with psoriasis.[14-19] Enrollment skewed predominantly male (65%–82%), with a mean age ranging from the early 40s to 50s. Participants had moderate-to-severe psoriasis, with a mean disease duration of 13.8 to 19.3 years[14,15,18] and a median disease duration of 12.3 to 15.0 years.[16,19,20] Prior biologic exposure varied, with treatment-naive rates ranging from 23% to ~60%.[14,15,17-19] Common previous biologics included adalimumab, etanercept, secukinumab, and ustekinumab.

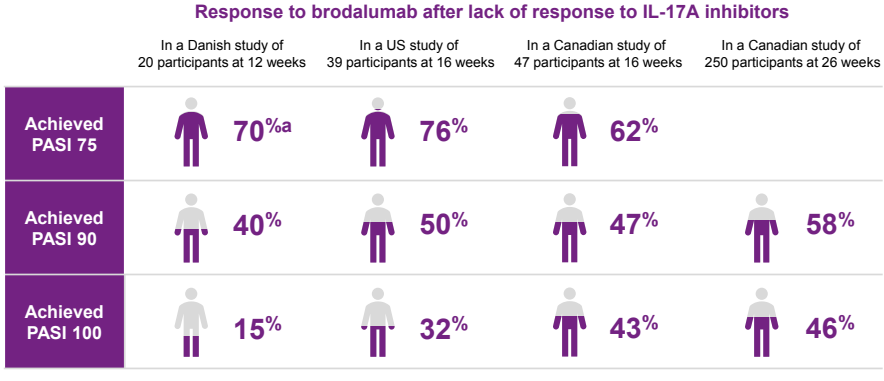
Two studies were identified from the open-label, multicenter, real-world, prospective, noninterventional, single-arm, observational LIBERO study, which enrolled participants with plaque psoriasis treated with brodalumab. In the Czech LIBERO study of 54 participants with moderate-to-severe psoriasis, the effectiveness of brodalumab was evaluated through 52 weeks.[14] At week 12, rates of 75%, 90%, and 100% improvement in psoriasis area and severity index (PASI 75, 90, and 100) were 93%, 85%, and 60%, respectively, which increased to 98%, 88%, and 76%, respectively, by week 52 (n=49 [patients who completed all 52 weeks]). Additionally, the mean PASI score decreased from 16.1 at baseline to 7.2 at week 2, demonstrating a rapid response to treatment, and to 1.0 at week 12. After 52 weeks, the mean PASI score was further reduced to 0.5. The German LIBERO study enrolled 638 participants, and effectiveness was monitored through 52 weeks.[15] Similar to the Czech LIBERO study, high rates of PASI 75, 90, and 100 were observed at week 12 (78%, 62%, and 35%, respectively) and week 52 (85%, 74%, and 53%, respectively). Mean PASI score decreased from 17.2 at baseline to 9.7 at week 2 and to 3.3 at week 12. These findings demonstrate brodalumab's rapid onset of action and sustained effectiveness in real-world settings in 2 European populations.

A long-term, multicenter, open-label extension study was conducted in 129 Japanese participants who had completed 64 weeks of previous brodalumab treatment to examine the long-term effectiveness of brodalumab over ≥108 weeks.[16] Participants could start with a reduced dose of brodalumab (140 mg), and all eventually received doses up to 210 mg upon approval of the drug in Japan. Participants had scalp involvement (94%) and/or nail involvement (63%), and the effectiveness of brodalumab was measured for these manifestations via the psoriasis scalp severity index (PSSI) and nail psoriasis severity index (NAPSI). Mean PASI score decreased from baseline to week 28 (from 24.7 to 1.0) and remained low through 108 weeks (0.20) and end of study (0.0). Mean PSSI and NAPSI scores at baseline were 25.0 and 7.0, respectively; scores for both decreased to 0 by the end of the study. Another Japanese open-label study (ProLOGUE) of 73 participants examined the effectiveness of brodalumab through 48 weeks.[19] Median PASI score significantly decreased, from 12.1 at baseline to 0.0 at week 12 (P<0.0001), and PASI scores were maintained between weeks 12 and 48 (baseline to week 48, P<0.0001; week 12 to 48, P>0.1). Participants also completed self-evaluations using the patient global assessment; 90% and 91% reported brodalumab was effective at weeks 12 and 48, respectively, reflecting agreement between participants and physicians. We identified additional subanalyses of ProLOGUE that demonstrated the effectiveness of brodalumab in this patient population with respect to skin pain, itching, and improvements in health-related quality of life, work productivity, anxiety, and depression (but not sleep problems).[21-25]

In a retrospective, single-center Italian study, 199 participants with moderate-to-severe psoriasis were treated with brodalumab for up to 156 weeks.[17] At week 16, rates of PASI 90 and 100 were 66% and 54%, respectively, and at week 156, these rates were maintained (66% and 55%, respectively; n=29 [percentages were based on the number of nonmissing values]). Mean PASI score at baseline was 13.6, had decreased to 1.9 by week 16, and decreased further to 1.2 by week 156. With the longest follow-up duration among the studies summarized here, this research demonstrates brodalumab's rapid and sustained effectiveness over ~3 years of treatment.

An observational, prospective, multicenter Greek study (BrIDGE) evaluated the effectiveness of brodalumab in 200 participants with moderate-to-severe psoriasis for 104 weeks.[18] Mean PASI improved by 94.5% from baseline to week 104. Additionally, the rate of PASI 100 at week 24 was 42% (n=71/169 [as observed]), which increased to 65% (n=89/137 [as observed]) by week 104. Among 71 participants who achieved PASI 100 by week 24, 90% retained complete clearance at weeks 52 and 104. Taken together, these studies highlight the rapid and durable response of brodalumab across diverse populations.

FIGURE 3. PASI response rates to brodalumab treatment in real-world studies of patients with prior IL-17A inhibitor failure.[13,26-28]



IL, interleukin; PASI, psoriasis area and severity index. [a]Indicates a predefined response endpoint of PASI 75 and/or PASI ≤2.

Brodalumab in patients whose disease did not respond to prior IL-17A inhibitors

Four studies, based in the United States (1), Denmark (1), and Canada (2), demonstrated brodalumab's effectiveness in patients with moderate-to-severe psoriasis that had failed to respond to prior IL-17A inhibitors (Figure 3).[13,26-28] Participants were predominantly male (57%–66%), with a mean age in the early 50s.

An open-label US study enrolled 39 participants with moderate-to-severe psoriasis that had failed to respond to secukinumab or ixekizumab (defined as ≥3 months of treatment without achieving PASI 75 or with a 50% loss of original improvement).[13] After 16 weeks of brodalumab, 76% had achieved PASI 75, 50% had achieved PASI 90, and 32% had achieved PASI 100.

Similarly, a Danish study investigated the effectiveness of brodalumab in 20 participants who experienced primary failure (defined as a relative reduction in PASI 50 after 3 months) or secondary failure (defined as an initial response followed by loss of response) to secukinumab and/or ixekizumab.[26] After 12 weeks of brodalumab, 70% had achieved the predefined response of PASI 75 and/or PASI ≤2. More than one-third (35%) of participants maintained response throughout 52 weeks; additionally, 40% achieved PASI 90 by 12 weeks, and 25% achieved PASI 90 by weeks 26 and 52. Rates of PASI 100 were 15%, 10%, and 15% at weeks 12, 26, and 52, respectively. All (n=3/3) participants who discontinued prior treatment due to primary failure and 69% (n=11/16) of participants who discontinued due to secondary failure achieved PASI 75 and/or PASI ≤2 by 12 weeks.

A retrospective, multicenter Canadian study of 47 participants who previously discontinued secukinumab or ixekizumab due to nonresponse, response optimization, or adverse events treated participants with brodalumab for 16 weeks.[27] At week 16, the rates of PASI 75, 90, and 100 were 62%, 47%, and 43%, respectively. A higher percentage of participants who switched from secukinumab achieved PASI 100 (57%) compared with participants who switched from ixekizumab (31%). Additionally, when stratified by type of nonresponse, a higher percentage of secondary nonresponders achieved PASI 100 with brodalumab (secukinumab, 62%; ixekizumab, 43%) compared with primary nonresponders (secukinumab, 25%; ixekizumab, 13%). In a Canadian phase 4 study of 250 participants who had inadequately responded to a previous biologic after ≥12 weeks of stable-dose treatment (per investigator judgment) and were subsequently treated with brodalumab, rates of PASI 90 and 100 were 54% and 40%, respectively, at week 16 and improved to 58% and 46%, respectively, by week 26.[28]

Unlike the AMAGINE-1/-2/-3 trials, which did not include patients with prior IL-17A inhibitor exposure,[8,10] these studies collectively demonstrate brodalumab's effectiveness in treating patients with prior IL-17A inhibitor failure. Brodalumab's unique MOA, which blocks signaling of multiple IL-17 cytokines, likely underlies its effectiveness in this treatment-resistant population. Despite the heterogeneous definitions of treatment failure, the consistent effectiveness of brodalumab across studies suggests its value as an alternative for patients with prior IL-17A inhibitor failure.

Studies of Biologics Inclusive of Brodalumab

Two studies from European populations demonstrated the rapid and superior effectiveness of brodalumab compared with other biologics in the treatment of moderate-to-severe psoriasis.[29,30] In a retrospective Greek study of 154 older participants (aged ≥65 years), 16 (10%; n=16/154) had been prescribed brodalumab; other biologics prescribed included adalimumab, etanercept, apremilast, ustekinumab, secukinumab, and infliximab.[29] Across all biologics, brodalumab was associated with the highest response rates: 100% of participants receiving brodalumab achieved PASI 75 at all time points measured (12, 24, and 52

weeks and 3 years), and 100% achieved PASI 90 at 24 and 52 weeks and 3 years. In an Italian retrospective review of 1057 participants treated with IL-17A inhibitors (secukinumab, ixekizumab), an IL-17RA inhibitor (brodalumab), or IL-23 inhibitors (guselkumab, risankizumab, or tildrakizumab), 203 (19%) had been treated with brodalumab.[30] Among all biologics examined, brodalumab had the highest rates of PASI 90 (66%) and PASI ≤3 (80%) at the study's earliest time point of 16 weeks. Rates for brodalumab remained highest through week 28 (PASI 90, 77%; PASI ≤3, 90%) and were consistent with other biologics' rates at week 52. These findings highlight the consistent real-world effectiveness of brodalumab, characterized by a rapid onset of action and often superior response rates compared with other biologic therapies. Brodalumab's rapid onset of effect has also been discussed in previous review articles.[31-33]

Other Forms of Psoriasis

Two open-label studies evaluated the effectiveness of brodalumab in difficult-to-treat psoriasis subtypes.[34,35] A Greek study demonstrated the effectiveness of brodalumab in 30 participants with nail psoriasis.[34] At week 12, brodalumab was associated with a significant improvement from baseline in mean NAPSI score for fingernail involvement (from 19.6 to 9.6; $P<0.001$) and toenail involvement (from 24.9 to 16.1; $P<0.001$). Significant improvement continued through week 24 (mean fingernail NAPSI score, 2.63; mean toenail NAPSI score, 7.2; $P<0.001$ from baseline for both). Additionally, at week 24, 100% of participants with fingernail involvement and 97% of participants with toenail involvement had achieved 50% improvement in NAPSI. Another open-label study of brodalumab in Japan was conducted in 12 participants with generalized pustular psoriasis (GPP) and 18 participants with psoriatic erythroderma (PsE).[35] In participants with GPP, 92% achieved "improved" or "remission" status on the clinical global impression of improvement scale by week 52; additionally, pustular symptom scores had decreased from an average of 4.4 at baseline to 0.5 at week 52, with 92% of patients achieving minimal disease (score 0 or 1). By 52 weeks, the rates of PASI 75 and 90 in the GPP cohort were 83% for each and the rate of PASI 100 was 58%. In participants with PsE, 100% achieved "improved" or "remission" status by week 52. Rapid improvement in PASI was observed in participants with PsE, with a mean PASI score improvement of 48% at week 2; by week 52, the rates of PASI 75 and 90 were 89% for each, and the rate of PASI 100 was 61%. Together, these findings support the effectiveness of brodalumab for nail psoriasis, GPP, and PsE and are particularly impactful given historically limited treatment options for these difficult-to-treat manifestations of psoriasis.

CONCLUSION

This analysis demonstrated the consistent postapproval effectiveness of brodalumab in the treatment of moderate-to-severe psoriasis across diverse patient populations. International evidence supported brodalumab's rapid onset of action, sustained effectiveness over extended periods (≤3 years), and effectiveness in patients with prior IL-17A inhibitor failure, which may be explained by its unique MOA. Comparative studies position brodalumab favorably against other biologics, with faster response rates. Additionally, brodalumab demonstrated promising results in difficult-to-treat psoriasis subtypes. Collectively, this body of evidence establishes brodalumab as a valuable therapeutic option in the psoriasis treatment armamentarium.

The effectiveness data in this analysis, which included 14 of the 18 studies previously identified for our safety review (Lebwohl et al, unpublished data, 2025), complement the safety findings and support the use of brodalumab in real-world settings. The 18 postapproval open-label and real-world clinical studies in the safety review spanned 8 countries and 1701 patients. Overall, rates of adverse events of special interest (eg, inflammatory bowel disease, major adverse cardiac events, malignancy) were low, and a causal link between brodalumab and suicide was not supported. Evidence across studies demonstrates the tolerable benefit-risk profile of brodalumab, particularly for those with prior biologic failure.

Although real-world studies of brodalumab have demonstrated its effectiveness, several limitations should be considered, including variations in geographic regions, follow-up duration, and baseline characteristics (eg, treatment history, male predominance). While these limitations reflect the inherent challenges of real-world evidence, they also provide valuable insights into brodalumab's performance in clinical practice beyond randomized controlled trials. Future studies with extended follow-up periods will further enhance the understanding of brodalumab's long-term safety and effectiveness profile in routine clinical practice.

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ORIGINAL ARTICLE

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ChatGPT and DeepSeek in Dermatologic Practice: Do Artificial Intelligence Models Adhere to Psoriasis Treatment Guidelines?

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ABSTRACT

Background: The integration of artificial intelligence (AI), particularly large language models (LLMs), into healthcare has rapidly expanded. In dermatology, machine learning is increasingly employed for diagnosis, prognosis, and treatment planning. However, the reliability of AI-generated recommendations, especially in chronic conditions such as psoriasis, remains insufficiently explored.

Objective: This study aims to evaluate the alignment of two prominent LLMs—ChatGPT and DeepSeek—with the clinical guidelines for psoriasis treatment issued by the American Academy of Dermatology (AAD).

Methods: Thirty-one guideline-based questions were formulated using the 2021 AAD-NPF guidelines. Each question was presented to ChatGPT-4 and DeepSeek. Responses were evaluated by two board-certified dermatologists blinded to the model source and rated as either concordant or discordant with the guidelines. Discrepancies were resolved by a third reviewer. Concordance rates were calculated according to the strength of recommendations, and inter-model agreement was assessed using Cohen's kappa coefficient.

Results: Both ChatGPT and DeepSeek demonstrated an overall concordance rate of 87.1%. While both models fully aligned with strong recommendations, ChatGPT showed higher concordance with moderate recommendations (87.5% vs 81.3%), whereas DeepSeek outperformed ChatGPT in scenarios involving limited recommendations (66.7% vs 33.3%). Inter-model agreement was moderate ($\kappa = 0.43$).

Conclusion: Although ChatGPT and DeepSeek show promise in aligning with evidence-based dermatologic care, inconsistencies, particularly in cases with limited evidence, highlight the necessity of clinical oversight. AI may serve as a valuable adjunct in psoriasis management; however, its safe integration into practice requires careful validation and context-sensitive application.

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INTRODUCTION

Machine learning (ML), a subset of artificial intelligence (AI), is a computational approach that utilizes input data to achieve specific goals without relying on explicitly programmed instructions.[1] Large language models (LLMs), designed to interpret, generate, and refine human language, are becoming increasingly prevalent in healthcare due to their ability to support clinical decision-making. In dermatology, ML has been applied to diagnostic imaging to assist in identifying skin conditions such as melanoma, psoriasis, and eczema.[2-5] It has also been employed to predict treatment responses, optimize personalized treatment plans, and improve patient outcomes.

With growing reliance on online health information, an estimated 80% of internet users in the United States seek medical guidance through digital platforms.[2] As AI-powered chatbots gain prominence, understanding the accuracy of the information they provide becomes critical, especially for chronic conditions like psoriasis.[4] Recent studies investigating the reliability of AI-generated medical advice have raised concerns regarding the accuracy and trustworthiness of such responses.[6-9] For instance, while LLMs like ChatGPT and DeepSeek offer accessible health-related insights, research indicates that they may rely on non-evidence-based sources, heightening concerns about misinformation.

This study aims to evaluate the accuracy of psoriasis treatment recommendations provided by two widely used LLMs, ChatGPT and DeepSeek, compared to the clinical guidelines of the American Academy of Dermatology (AAD). We hypothesize that these AI models may not consistently align with evidence-based recommendations and that AI-generated medical guidance in dermatology must be critically assessed.

TABLE 1.

The 2021 Joint AAD–NPF Guidelines of care for the Management and Treatment of Psoriasis With Topical Therapy and Alternative Medicine Modalities				
1. Strong evidence supports that use of class 1, class 2, and class 3–5 topical corticosteroids for up to 4 weeks is recommended for the treatment of plaque psoriasis not involving intertriginous areas	A	Is the use of class 1, class 2, and class 3–5 topical corticosteroids recommended for the treatment of plaque psoriasis not involving intertriginous areas for up to 4 weeks?	Concordant	Concordant
2. Strong evidence supports that use of class 1–7 topical corticosteroids for a minimum of up to 4 weeks is recommended as initial and maintenance treatment of scalp psoriasis	A	Is the use of class 1–7 topical corticosteroids recommended as initial and maintenance treatment of scalp psoriasis for a minimum of up to 4 weeks?	Concordant	Concordant
3. Limited evidence supports that use of topical Ccorticosteroids for >12 weeks can be considered if done under the careful supervision of a physician	C	Is the use of topical corticosteroids for >12 weeks can be considered if done under the careful supervision of a physician?	Concordant	Concordant
4. Moderate evidence supports that off-label use of 0.1% tacrolimus for psoriasis involving the face as well as inverse psoriasis for up to 8 weeks can be considered	B	Is the off-label use of 0.1% tacrolimus can be considered for psoriasis involving the face as well as inverse psoriasis for up to 8 weeks?	Concordant	Concordant
5. Moderate evidence supports that off-label use of pimecrolimus for inverse psoriasis for 4–8 weeks is recommended	B	Is the off-label use of pimecrolimus recommended for inverse psoriasis for 4–8 weeks?	Concordant	Concordant
6. Limited evidence supports that long-term use of tacrolimus or pimecrolimus can be considered for inverse psoriasis treatment as off- label use	C	Is the long-term use of tacrolimus or pimecrolimus can be considered for inverse psoriasis treatment as off-label use?	Discordant	Concordant
7. Moderate evidence supports that off-label combination of tacrolimus and 6% salicylic acid for 12 weeks may be used for the treatment of plaque psoriasis	B	Is the off-label combination of tacrolimus and 6% salicylic acid may be used for the treatment of plaque psoriasis for 12 weeks?	Discordant	Discordant
8. Strong evidence supports that long-term use of topical vitamin D analogues (up to 52 weeks), including calcipotriene/ calcipotriene, calcitriol, tacalcitol, and maxacalcitol, is recommended for the treatment of mild to moderate psoriasis	A	Is the long-term use of topical vitamin D analogues (up to 52 weeks), including calcipotriene/ calcipotriene, calcitriol, tacalcitol, and maxacalcitol, recommended for the treatment of mild to moderate psoriasis?	Concordant	Concordant
9. Strong evidence supports that Use of calcipotriene foam and calcipotriene plus betamethasone dipropionate gel is recommended for 4–12 weeks for the treatment of mild to moderate scalp psoriasis	A	Is the use of calcipotriene foam and calcipotriene plus betamethasone dipropionate gel recommended for 4–12 weeks for the treatment of mild to moderate scalp psoriasis?	Concordant	Concordant
10. Moderate evidence supports that topical tacalcitol ointment or calcipotriene combined with hydrocortisone for 8 weeks can be used for the treatment of facial psoriasis	B	Is the topical tacalcitol ointment or calcipotriene combined with hydrocortisone can be used for the treatment of facial psoriasis for 8 weeks?	Concordant	Concordant
11. Strong evidence supports that use of combination treatments with vitamin D analogues and potent class II and class III topical corticosteroids up to 52 weeks is recommended for the treatment of psoriasis	A	Is the use of combination treatments with vitamin D analogues and potent class II and class III topical corticosteroids up to 52 weeks recommended for the treatment of psoriasis?	Concordant	Concordant
12. Strong evidence supports that use of combination products with calcipotriol and corticosteroids is recommended for the treatment of psoriasis	A	Is the use of combination products with calcipotriol and corticosteroids recommended for the treatment of psoriasis?	Concordant	Concordant
13. Moderate evidence supports that the application of vitamin D analogues twice daily on weekdays in conjunction with high- potency topical corticosteroids twice daily on weekends can be considered for maintenance treatment for psoriasis	B	Is the application of vitamin D analogues twice daily on weekdays in conjunction with high- potency topical corticosteroids twice daily on weekends can be considered for maintenance treatment for psoriasis?	Concordant	Concordant
14. Moderate evidence supports that the application of morning high-potency topical corticosteroids and evening topical vitamin D analogues is an effective treatment regimen that can be considered for the treatment of psoriasis	B	Is the application of morning high-potency topical corticosteroids and evening topical vitamin D analogues an effective treatment regimen that can be considered for the treatment of psoriasis?	Concordant	Concordant
15. Moderate evidence supports that topical tazarotene can be used for the treatment of mild to moderate psoriasis	B	Is the topical tazarotene can be used for the treatment of mild to moderate psoriasis?	Concordant	Concordant
16. Moderate evidence supports that topical tazarotene can be used for the treatment of nail psoriasis	B	Is the topical tazarotene can be used for the treatment of nail psoriasis?	Concordant	Discordant
17. Moderate evidence supports that combination of topical tazarotene and NB-UVB has been shown to be effective and allow a eduction in total use of NB-UVB	B	Is the combination of topical tazarotene and NB-UVB has been shown to be effective and allow a eduction in total use of NB-UVB?	Concordant	Concordant

TABLE 1. (CONTINUED)

The 2021 Joint AAD–NPF Guidelines of care for the Management and Treatment of Psoriasis With Topical Therapy and Alternative Medicine Modalities				
18. Strong evidence supports that use of mid- or high-potency topical corticosteroid in combination with tazarotene for 8-16 weeks is more effective than monotherapy with tazarotene and is recommended for the treatment of mild to moderate psoriasis	A	Is the use of mid- or high-potency topical corticosteroid in combination with tazarotene for 8- 16 weeks more effective than monotherapy with tazarotene and recommended for the treatment of mild to moderate psoriasis?	Concordant	Concordant
19. Strong evidence supports that use of topical corticosteroids along with tazarotene is recommended to decrease the duration of treatment as well as increase the length of remission	A	Is the use of topical corticosteroids along with tazarotene recommended to decrease the duration of treatment as well as increase the length of remission?	Concordant	Concordant
20. Moderate evidence supports that use of an emollient in conjunction with topical corticosteroids for 4 to 8 weeks can be used to help reduce itching, desquamation, and total body surface area and prevent quick relapse of psoriasis when topical corticosteroids are discontinued	B	Is the use of an emollient in conjunction with topical corticosteroids for 4 to 8 weeks can be used to help reduce itching, desquamation, and total body surface area and prevent quick relapse of psoriasis when topical corticosteroids are discontinued?	Concordant	Concordant
21. Moderate evidence supports that topical salicylic acid can be used for 8–16 weeks for the treatment of mild to moderate psoriasis	B	Is the topical salicylic acid can be used for 8–16 weeks for the treatment of mild to moderate psoriasis?	Concordant	Concordant
22. Moderate evidence supports that combination of salicylic acid with topical corticosteroids can be used for the treatment of moderate to severe psoriasis (body surface area ≤20%)	B	Is the combination of salicylic acid with topical corticosteroids can be used for the treatment of moderate to severe psoriasis (body surface area ≤20%)?	Concordant	Concordant
23. Moderate evidence supports that topical anthralin for 8–12 weeks can be used for the treatment of mild to moderate psoriasis. Short contact (up to 2 hours per day) anthralin is recommended to limit adverse side effects	B	Is the topical anthralin for 8–12 weeks can be used for the treatment of mild to moderate psoriasis? Does short contact (up to 2 hours per day) anthralin is recommended to limit adverse side effects?	Concordant	Concordant
24. Strong evidence supports that coal tar preparations are recommended for the treatment of mild to moderate psoriasis	A	Is the coal tar preparations recommended for the treatment of mild to moderate psoriasis?	Concordant	Discordant
25. Moderate evidence supports that according to the joint AAD- NPF phototherapy guideline,[90] there is sufficient evidence to recommend the use of Goeckerman therapy for the treatment of psoriasis	B	According to the joint AAD-NPF phototherapy guideline,[90] Is there sufficient evidence to recommend the use of Goeckerman therapy for the treatment of psoriasis?	Discordant	Concordant
26. Strong evidence supports that addition of an ultrahigh potency (class 1) topical corticosteroid to standard dose etanercept for 12 weeks is recommended for the treatment of moderate to severe psoriasis	A	Is the addition of an ultrahigh potency (class 1) topical corticosteroid to standard dose etanercept for 12 weeks recommended for the treatment of moderate to severe psoriasis?	Concordant	Concordant
27. Moderate evidence supports that addition of calcipotriene/betamethasone to standard dose adalimumab for 16 weeks is recommended for the treatment of moderate to severe psoriasis to accelerate clearance of psoriatic plaques.	B	Is the addition of calcipotriene/betamethasone to standard dose adalimumab for 16 weeks recommended for the treatment of moderate to severe psoriasis to accelerate clearance of psoriatic plaques?	Concordant	Concordant
28. Limited evidence supports that all topical corticosteroids can be used in combination with any biologics for the treatment of moderate to severe psoriasis	C	Can all topical corticosteroids be used in combination with any biologics for the treatment of moderate to severe psoriasis?	Discordant	Discordant
29. Strong evidence supports that addition of topical calcipotriene to standard dose methotrexate therapy is recommended for the treatment of moderate to severe psoriasis. It may lead to lower cumulative doses of methotrexate and increased time to relapse after methotrexate discontinuation	A	Is the addition of topical calcipotriene to standard dose methotrexate therapy recommended for the treatment of moderate to severe psoriasis? May it lead to lower cumulative doses of methotrexate and increased time to relapse after methotrexate discontinuation?	Concordant	Concordant
30. Moderate evidence supports that addition of calcipotriene/ betamethasone dipropionate ointment to low dose (2 mg/kg/d) cyclosporine can be used for the treatment of moderate to severe psoriasis	B	Is the addition of calcipotriene/ betamethasone dipropionate ointment to low dose (2 mg/kg/d) cyclosporine can be used for the treatment of moderate to severe psoriasis?	Concordant	Concordant
31. Strong evidence supports that addition of calcipotriene to standard dose acitretin is recommended for the treatment of moderate to severe psoriasis.	A	Is the addition of calcipotriene to standard dose acitretin recommended for the treatment of moderate to severe psoriasis?	Concordant	Concordant

MATERIALS AND METHODS

This study evaluated the accuracy of two LLMs, ChatGPT-4 and DeepSeek, in providing psoriasis treatment recommendations based on established clinical practice guidelines (CPGs). The 2021 joint AAD-NPF care guidelines for the management and treatment of psoriasis using topical therapies and alternative modalities were used as the reference standard for comparison.[10]

Selection of Guidelines

A total of 31 core recommendations were selected from psoriasis treatment guidelines for analysis. The responses of AI models to 31 questions concerning psoriasis management were assessed in light of current clinical guidelines. Initially, the specific guideline items from which each question was derived were identified, and sample questions were presented. For example, the question "What criteria should be considered when prescribing a topical corticosteroid to a patient?" was matched with the item titled "Use of topical corticosteroids" from the 2016 Psoriasis Treatment Guidelines. Each question was paired with the corresponding guideline recommendation, and the accuracy of responses was assessed based on these items. Each guideline recommendation and related questions are determined in Table 1.

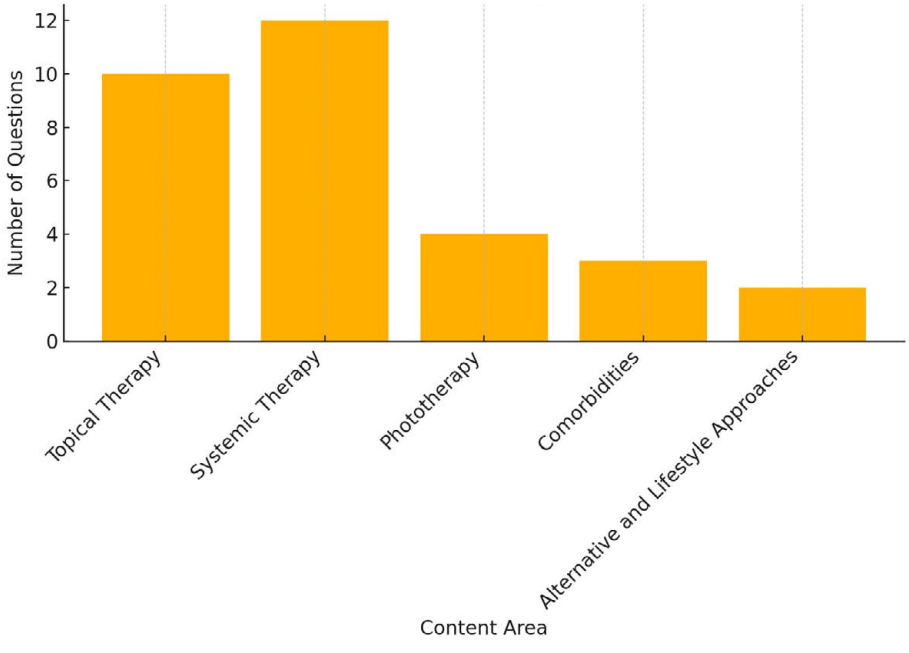
A rubric-based evaluation approach was adopted. Each recommendation was categorized into one of three classifications according to its assigned strength: strong, moderate, or limited. For example, responses that fully matched the guideline were labeled as "Fully Concordant," those with minor omissions or ambiguity were classified as "Partially Concordant," and responses that contradicted or misrepresented the guidelines were deemed "Discordant." Rubric criteria (eg, "Is the treatment dosage correct?", "Is any misinformation present?") were explicitly defined.

Question Formulation and Data Collection

To ensure clarity and consistency in LLM queries, each guideline was transformed into a structured question format. The phrasing of the questions was carefully crafted to preserve critical information while maintaining uniformity across prompts. Each structured question was systematically presented to both ChatGPT-4 and DeepSeek. To standardize the responses, follow-up prompts were not permitted, and chat history was cleared before each query to minimize memory-based bias.

The 31 questions used in the study were compiled to cover various aspects of psoriasis treatment. Treatment methods in the question set were categorized into groups such as topical treatments, systemic therapies (traditional drugs and biologics), phototherapy, psoriasis-related comorbidities, lifestyle recommendations, and alternative approaches. To facilitate detailed performance analysis, the questions were grouped by content area: Topical Therapy (10 questions related to local steroid and ointment treatments), Systemic Therapy (12 questions on drugs such as methotrexate, cyclosporine, and biologics), Phototherapy (4 questions regarding sun exposure, UVB/PUVA irradiation), Comorbidities (3 questions on psoriatic arthritis, metabolic syndrome, etc.), Alternative and Lifestyle Approaches (2 questions concerning diet, stress management; Figure 1).

FIGURE 1. Number of questions by content area.



Blinded Evaluation of Responses

Responses from both LLMs were formatted into a standardized survey and independently assessed by two board-certified dermatologists who were blinded to the model source. In cases of disagreement, a senior dermatologist made the final decision. Each response was categorized as either concordant or discordant based on its alignment with the psoriasis CPG recommendations.

Statistical Analysis

All data were analyzed using Microsoft Excel to determine interrater agreement rates and levels of concordance. To prevent temporal bias in LLM-generated responses, all queries were conducted on the same date—March 17, 2025. Cohen's kappa coefficient was calculated to measure the consistency of dual assessments. The resulting Cohen's kappa value was 0.72 (P<0.001), indicating a good level of agreement between the two raters. This strengthened the reliability of the data collection process and contributed to the validity of the study's findings.

RESULTS

Overall Concordance Rates

ChatGPT provided guideline-concordant answers to 27 of the 31 psoriasis guideline questions (87.1%) and discordant responses to 4 (12.9%). DeepSeek showed identical performance, with 27 concordant (87.1%) and four discordant (12.9%) responses. In absolute terms, both models demonstrated high overall concordance with established guidelines. Table 3 summarizes the counts and percentages of concordant/discordant responses for each model.

Concordance by Strength of Recommendation

Concordance varied according to the strength of the guideline recommendations (strong = A, moderate = B, limited = C). Both models performed perfectly on questions involving strong recommendations (A), correctly aligning with the guidelines in 100% of such cases (12/12 for each). For moderate recommendations (B), ChatGPT was concordant in 14 out of 16 questions (87.5%), slightly outperforming DeepSeek, which was concordant in 13 out of 16 (81.3%). The greatest performance disparity emerged in questions involving limited evidence (C): ChatGPT correctly aligned with only 1 of 3 such questions (33.3%), while DeepSeek correctly answered 2 out of 3 (66.7%). This suggests that both models struggled with limited-evidence scenarios, with ChatGPT performing particularly poorly in this category. Table 2 provides a detailed breakdown of performance by recommendation strength for each model.

Inter-Model Agreement

When directly comparing the models, ChatGPT and DeepSeek agreed on the guideline-concordance outcome for 27 out of 31 questions (87% agreement). In 25 of those questions, both models gave concordant responses, and in 2 cases, both were discordant. In the remaining 4 cases (13%), the models disagreed: one model's response was concordant, while the other's was discordant. Specifically, ChatGPT was discordant on two questions (#6 and #25) that DeepSeek answered correctly, while DeepSeek was discordant on two different questions (#15 and #16) that ChatGPT answered correctly. Table 3 shows the agreement matrix between the two AI models.

Based on these outcomes, the inter-model reliability between ChatGPT and DeepSeek was only moderate. Cohen's kappa coefficient was approximately $\kappa = 0.43$, indicating a modest level of agreement beyond chance despite a high overall percentage concordance. This reflects the tendency of both models to perform well on well-supported questions (categories A and B), but to diverge on a handful of more ambiguous cases, primarily category B/C questions. Overall, although both models performed similarly in aggregate, their differing failures on specific questions led to a moderate level of agreement between them.

TABLE 2.

Concordance of ChatGPT and DeepSeek With Psoriasis Treatment Guidelines, by Strength of Recommendation

Recommendation Strength	ChatGPT Concordant (n, %)	ChatGPT Discordant (n, %)	DeepSeek Concordant (n, %)	DeepSeek Discordant (n, %)
Strong (A) (n = 12)	12 (100%)	0 (0%)	12 (100%)	0 (0%)
Moderate (B) (n = 16)	14 (87.5%)	2 (12.5%)	13 (81.3%)	3 (18.7%)
Limited (C) (n = 3)	1 (33.3%)	2 (66.7%)	2 (66.7%)	1 (33.3%)
Overall (N = 31)	27 (87.1%)	4 (12.9%)	27 (87.1%)	4 (12.9%)

TABLE 3.

Cross-classification of ChatGPT vs DeepSeek Concordance Outcomes (Number of Questions)

ChatGPT vs DeepSeek	DeepSeek Concordant	DeepSeek Discordant	Total
ChatGPT Concordant	25	2	27
ChatGPT Discordant	2	2	4
Total	27	4	31

DISCUSSION

The findings of this study demonstrate that both ChatGPT and DeepSeek achieved a high level of concordance (87.1%) with clinical practice guidelines for the treatment of psoriasis. When performance was analyzed by category, high accuracy was observed for questions related to topical and systemic therapies. However, the models produced more errors in questions regarding biologic treatments and phototherapy. In the domains of comorbidities and alternative treatments, the responses were often insufficient or incomplete. For instance, in a low-evidence question concerning alternative therapies, the model provided unreliable information.

Although the overall concordance rates were identical, the models showed differing performance patterns when stratified by strength of recommendation. While both models fully aligned with strong recommendations, ChatGPT performed slightly better with moderate recommendations, whereas DeepSeek showed higher accuracy in scenarios supported by limited evidence. These variations suggest that despite similar overall accuracy, the underlying strength of evidence may influence how each language model interprets and responds to clinical queries.

These results are consistent with a growing body of research investigating the role of AI in dermatology.[2,11-14] As a visually driven specialty with high patient volumes, dermatology is particularly well-suited for leveraging AI technologies. Psoriasis, a chronic and complex disease managed largely through visual assessment, presents a compelling challenge for AI-driven applications.[15,16] Prior studies have shown that ML algorithms can assist in tasks such as lesion classification, segmentation, and even prediction of treatment outcomes, some achieving over 90% predictive accuracy using clinical or biomarker-based data.[6-8,17,18]

However, despite its promise, the application of AI in psoriasis still faces significant challenges. One major limitation is the variability and quality of training data. Images of skin lesions are often captured under non-standardized conditions, resulting in inconsistencies in lighting, resolution, and angle, which hinder model training and reproducibility. Furthermore, a lack of diversity in datasets, particularly regarding age, ethnicity, and skin type, can limit generalizability, especially for underrepresented populations such as pediatric patients. The omission of post-treatment features, such as pigmentation changes, further complicates lesion recognition in patients with darker skin tones.

Another critical concern lies in the interpretability of these models and their integration into real-world settings. While many algorithms perform well on retrospective datasets, their clinical efficacy and incorporation into daily dermatological practice remain insufficiently studied. The ability to predict treatment efficacy or identify subgroups of patients most likely to benefit from specific therapies is promising, yet such models require prospective validation in real-world environments. Additionally, more advanced, integrated systems are needed to synthesize multiple clinical features—such as lesion distribution, disease severity, and comorbidities—to deliver comprehensive and clinically relevant recommendations.

In line with previous studies,[16,19] our findings reinforce the notion that AI should be viewed as a supportive tool rather than a replacement for clinical expertise. LLMs such as ChatGPT and DeepSeek may aid clinicians by summarizing complex guidelines and supporting decision-making processes; however, they still lack the nuanced reasoning, contextual understanding, and clinical judgment of experienced dermatologists.[4,16] Moreover, the moderate agreement level between the two models (Cohen's kappa = 0.43) underscores the current limitations in consistency and reliability across different AI platforms.

AI models present several limitations. First, they may generate misleading content. For instance, when asked about a rare disease, a model may produce a detailed article-style response that includes references, many of which are fictitious. Such "hallucinated references" make it difficult to distinguish between fact and fabrication, potentially leading to erroneous treatment recommendations. In clinical practice, misinformation can have serious consequences; unawareness of a model's limitations may result in harmful guidance for patients.

Second, the models exhibit data-driven biases. LLMs such as ChatGPT are predominantly trained on English-language, open-access literature. This can result in underrepresentation of disease manifestations in different skin types and ethnic groups. For example, current deep learning models tend to have lower diagnostic accuracy for psoriasis and skin cancer in patients with darker skin. In general, when an AI algorithm is trained on data that does not reflect real-world diversity, its performance declines, and existing biases may be reinforced. In this study, the model made notable errors on questions related to underrepresented subpopulations in the training data. The lack of diversity in terms of ethnicity, age, and gender limited the model's ability to generate universally applicable responses.

Finally, AI may provide low-evidence answers to certain medical questions. In areas where scientific evidence is lacking, the model may rely on speculative reasoning or outdated information. In such cases, model outputs should be compared with expert judgment and, if necessary, validated through a literature review. Our study also found that errors were concentrated in low-evidence domains, reinforcing that AI should not be treated as an infallible source of medical knowledge.

CONCLUSION

Artificial intelligence holds substantial potential for enhancing the management of psoriasis, from improving diagnostic accuracy to facilitating personalized treatment strategies. However, realizing this potential requires addressing key challenges related to data quality, model transparency, and clinical validation. Through thoughtful integration and ongoing interdisciplinary collaboration, AI can become a valuable asset in dermatologic care, ultimately contributing to a more efficient, equitable, and patient-centered management of psoriasis. This comprehensive analysis highlights areas in which model performance is weak and underscores priority targets for future refinement.

Ethical Considerations

The ethical dimensions of AI-assisted applications in medicine are crucial. Models like ChatGPT may generate incorrect or incomplete information, which can negatively influence patient decision-making. Therefore, AI-generated recommendations should always be verified by a qualified professional. Excessive patient trust in AI also poses a risk; for example, patients may follow a model's advice without seeking expert consultation. As ChatGPT itself notes, AI should not replace physicians but should serve as a complementary tool. Human oversight and ethical judgment must always remain central. Additionally, it is important to acknowledge the risks AI poses regarding data privacy and patient autonomy. Overall, while this study demonstrates areas in which AI can provide guidance, it also emphasizes the boundaries of current models and the importance of ethical responsibility in clinical use.

Limitations

Regarding the scope of the questions included, the study encompassed key aspects of psoriasis management, including topical and systemic therapies, biologic agents, phototherapy, psoriatic arthritis, and other comorbidities. However, some areas were underrepresented. For example, questions related to complementary/alternative therapies or patient education were limited. Furthermore, an item directly addressing the impact of psoriasis on quality of life could be incorporated to provide a more comprehensive evaluation.

DISCLOSURES

The authors have no conflicts of interest to disclose.

Data Availability Statement: Data were available on request from the authors. The data that support the findings of this study are available from the corresponding author upon reasonable request.

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ORIGINAL ARTICLE

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Efficacy and Safety of Cysteamine-Isobionic Amide Complex in the Treatment of Periorbital Hyperpigmentation

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ABSTRACT

Periorbital hyperpigmentation is a common yet challenging cosmetic concern due to the thin, vascular, and pigment-prone nature of periocular skin, as well as its multifactorial etiology. Discoloration in this area can be driven by genetics, photoaging, dermal thinning, and pigmentary disorders, making treatment outcomes often unpredictable and temporary. The cysteamine–isobionic amide complex offers a novel, non-hydroquinone and non-retinoid approach, combining the multi-pathway pigment reduction of cysteamine with the barrier-supporting and pigment-evening properties of isobionic amide. This pilot study aimed to evaluate the safety, tolerability, and efficacy of the cysteamine-isobionic amide complex for periorbital hyperpigmentation using objective imaging and patient-reported outcomes. Seven participants self-administered treatment three to five times weekly for 10 weeks. Patient-reported outcomes demonstrated consistent improvements in pigmentation, radiance, and overall appearance, with 83.3% noting improvement in their primary concern and 100% indicating they would recommend the regimen. The treatment was well tolerated, with only one case of transient mild erythema. To our knowledge, this is one of the first studies to investigate the cysteamine–isobionic amide complex in the periorbital region, supporting its potential as a safe, at-home option for under-eye hyperpigmentation. Future controlled trials with larger and more diverse cohorts are warranted to confirm these preliminary findings and assess long-term efficacy.

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INTRODUCTION

The under-eye region remains one of the most prominent cosmetic concerns due to its thin skin and visibility.[1] Periorbital hyperpigmentation, often referred to as dark circles, is a multifactorial condition influenced by genetics, aging, vascular congestion, and pigmentary changes, and it is frequently cited by patients as a major aesthetic complaint.[2] As individuals age, dermal thinning, volume loss, and laxity accentuate periorbital hyperpigmentation, wrinkles, and puffiness, often conveying a prematurely aged or fatigued appearance.[3] These aesthetic changes can significantly impact self-esteem, emotional well-being, and overall quality of life.[4] Globally, the cosmetic eye care market is expected to exceed $28 billion USD in 2025, underscoring the high demand for effective treatments.[5] Traditional approaches to managing periorbital hyperpigmentation, such as cosmetic concealers, topical depigmenting agents, chemical peels, laser and light-based therapies, and surgical interventions have demonstrated variable and often temporary results.[2,6] These methods are frequently limited by safety concerns, inconsistent efficacy, and the need for repeated treatments, highlighting the ongoing need for more effective and durable solutions.[6]

The cysteamine–isobionic amide complex offers a novel, non-hydroquinone and non-retinoid approach to treating hyperpigmentation in the periorbital region. Cysteamine is a naturally derived aminothiol that reduces melanin synthesis through multiple mechanisms, including inhibition of tyrosinase and peroxidase activity, dopachrome quenching, iron and copper chelation, and elevation of intracellular glutathione, while also exerting antioxidant effects.[7] Isobionic-amide, a stabilized amide form of vitamin B3, supports epidermal barrier repair, enhances hydration, promotes even pigment distribution, and works synergistically with cysteamine to improve hyperpigmentation.[8] Additionally, both agents have been shown to reduce oxidative stress and inflammation in the skin microenvironment, creating conditions that are less favorable for pigment overproduction.[8] Together, they target

both the underlying biochemical pathways and the visible manifestations of pigmentary dark circles while maintaining overall skin health.

Despite the wide range of available topical brightening agents, there is a distinct gap in targeted, effective, and safe at-home therapies specifically formulated for the under-eye area. This study aims to address that gap by evaluating the safety, tolerability, and efficacy of the cysteamine-isobionic amide complex for periorbital hyperpigmentation, using both participant-reported outcomes and objective digital image analysis. Given the growing consumer demand for non-invasive, cost-effective, and home-based solutions, it is critical to assess the role of cysteamine-based therapy in improving under-eye pigmentation.

MATERIALS AND METHODS

Participants

This single-center pilot study was conducted between May and August 2025. All participants were adults who served as co-investigators and self-administered treatment using Cyspera Intensive System™ (Scientis, Geneva, Switzerland) three to five times per week. Exclusion criteria included pregnancy or planned pregnancy, breastfeeding, history of photosensitive disorders, or current use of photosensitizing medications. Because all individuals were investigators evaluating the product on themselves and no identifiable private information was collected, the project did not constitute human subjects research as defined by federal regulations; therefore, Institutional Review Board (IRB) approval was not required.

Baseline Survey

At the initial visit, participants completed a baseline survey that included demographic information such as age, gender, and race. Participants rated various aspects of their under-eye appearance on a 5-point scale ranging from 0 (best) to 4 (worst). Features assessed included skin texture, under-eye dark circles, under-eye bags, under-eye radiance, and overall youthful appearance. Additionally, all participants identified their under-eye skin area as their primary concern.

Treatment Protocol

Participants applied the Cyspera Intensive System™ (Scientis, Geneva, Switzerland) in accordance with manufacturer guidelines.[9] Treatment was performed on unwashed skin, beginning with one pump of Cyspera Intensive™ applied in a thin, even layer to the under-eye area. During the first week, contact time was limited to approximately 3-5 minutes to assess tolerance, then gradually increased to a maximum of 15 minutes per session.[9] The product was removed with a gentle cleanser, followed by application of two pumps of Cyspera Neutralize™ and rinsing as directed.[9] One to two pumps of Cyspera Boost™ were then applied to moisturize and enhance treatment outcomes.[9] Participants performed this regimen 3-5 times weekly for 10 weeks. All participants were instructed to apply a broad-spectrum sunscreen (SPF ≥ 30) in the morning to prevent UV-induced pigmentation.

Photographs and Digital Analysis

Standardized frontal, left, and right facial photographs were captured using the VISIA® Complexion Analysis System (Canfield Scientific, Parsippany, NJ) at baseline and 10 weeks. Wrinkles in the under-eye area were quantitatively assessed in left and right views, with higher values corresponding to increased severity. The average wrinkle scores across participants were compared between the initial and final assessments. This imaging and analysis protocol was selected based on a prior study investigating under-eye rejuvenation.[10]

Patient-Reported Outcomes

After 10 weeks of treatment, participants returned and completed a follow-up survey. Participants rated the improvement of various aspects of their under-eye area on a 7-point Likert scale ranging from -3 (worst) to +3 (best), with 0 indicating no change, including improvement in under-eye skin texture, under-eye dark circles, under-eye bags, under-eye darkness or pigmentation, under-eye radiance, youthful appearance, and overall level of improvement in under-eye appearance. Additionally, participants provided feedback on their experience using the pigment correction system on a similar 7-point scale ranging from -3 (most negative) to +3 (most positive), with 0 indicating a neutral response, including overall satisfaction, comfort, and ease of use. Participants indicated if they would recommend the treatment to others, how the treatment compared to topical products, and side effects they experienced. Participants were also asked if the treatment improved their main under-eye concern.

Statistical Analysis

Post-treatment digital measurements of under-eye wrinkles obtained by the VISIA system were analyzed in comparison to baseline values with two-tailed t-tests using Microsoft Excel Version 16.83. Statistical significance was established at a *P*-value of less than 0.05. The data was analyzed on a per-protocol basis.

RESULTS

Seven participants were recruited. Six participants completed the protocol; one participant was excluded due to non-compliance. Five participants were female (83.3%). The mean age was (range 24–37). Three participants identified as Asian (50.0%), two as Hispanic or Latino (33.3%), and one as Black/African American (16.7%). Participants used the under-eye treatment approximately 4.2 ± 2.1 times a week.

Baseline Survey

Participants reported the following average scores for eye-area concerns: under-eye dark circles (3.17 ± 0.75), under-eye bags (2.33 ± 0.52), under-eye pigmentation (3.00 ± 0.63), under-eye skin texture (2.50 ± 0.55), under-eye radiance (2.50 ± 1.05), and

overall youthful appearance (1.83 ± 1.60). The primary concerns participants aimed to address with the treatment were dark circles and brightness.

Patient-Reported Outcomes

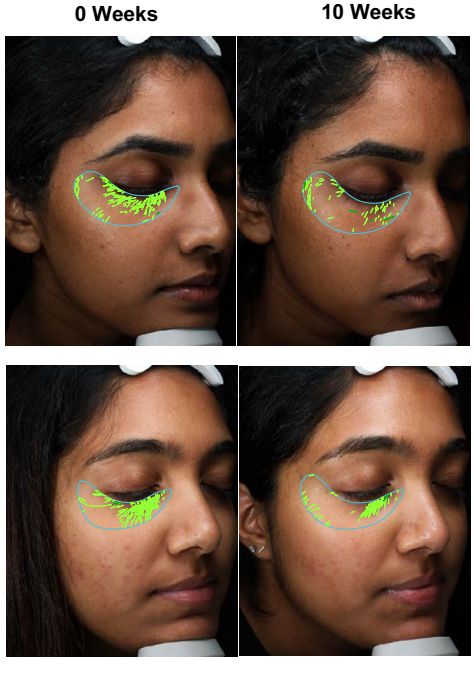
Participants consistently reported improvements across various aspects of their under-eye area, including improvement in dark circles (0.83 ± 0.98), under-eye bags (0.16 ± 0.75), darkness or pigmentation (1.00 ± 1.09), under-eye skin texture (0.50 ± 1.52), and under-eye radiance (0.50 ± 1.52). Additionally, participants endorsed a more youthful appearance (0.50 ± .84) and an overall improvement in under-eye appearance (1.00 ± 1.09). The user experience was also positive, with the treatment scoring high on ease of use (2.00 ± 0.63), comfort (1.67 ± 1.37), and overall satisfaction (1.50 ± 0.54), on a 7-point Likert scale ranging from -3 to +3, where +3 signifies very comfortable, easy to use, and highly satisfied. All participants (100%) indicated they would recommend the device to others and expressed a preference for the treatment over other topical products. Five participants indicated the treatment effectively addressed the main under-eye concern they indicated at baseline (83.3%).

Adverse events were minimal. The majority of participants indicated they had no side effects (83.3%); one participant indicated they had mild side effects, including minor erythema (16.7%). None of the participants reported moderate or severe side effects.

Digital Analysis

Participants' overall eye wrinkle scores improved, as indicated by an increase in average wrinkle percentile score (74.16% at baseline compared to 78.33% at 10 weeks). Despite participant self-reporting a meaningful visual improvement in their under-eye area, this improvement was not calculated to be statistically significant ($P>0.05$; Figure 1).

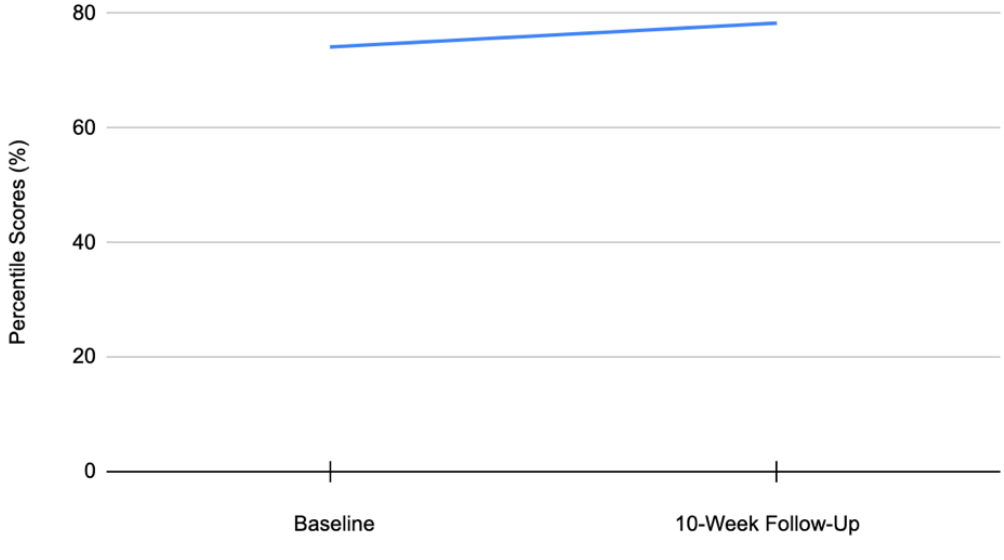
FIGURE 2. Canfield VISIA digital skin analysis of wrinkles in two female participants before and after ten weeks of treatment with cysteamine-isobionic amide complex. There is a significant decrease in under-eye wrinkles at 10 weeks.



DISCUSSION

This pilot study evaluated the safety, tolerability, and efficacy of cysteamine-isobionic amide complex for the treatment of periorbital hyperpigmentation. To our knowledge, this is one

FIGURE 1. Average digital analysis of wrinkle percentile scores improved from 0 to 10 weeks. Higher values indicate decreased severity.



of the first studies to investigate the use of this dual-action formulation specifically in the periorbital region. The findings suggest that the regimen was well tolerated, with a favorable user experience and perceived improvements in key under-eye concerns, particularly pigmentation and overall appearance. All participants reported a willingness to recommend the product to others, and the majority indicated that the treatment successfully addressed their primary aesthetic concern. Adverse events were minimal, with only one participant experiencing mild erythema that resolved without intervention.

The improvements reported by participants, most notably in under-eye darkness, pigmentation, and radiance, align with the known mechanisms of Cyspera's active ingredients. Cysteamine acts on multiple steps of the melanogenesis pathway while exerting antioxidant effects, and isobionic-amide supports barrier function, hydration, and pigment dispersion.[7] This dual-action approach addresses both the underlying cause of hyperpigmentation and the overall skin quality in the periorbital area, making it a potentially valuable non-hydroquinone option for at-home use.

When compared to other commonly used topical pigment-fading agents, cysteamine offers several potential advantages. Hydroquinone, while effective, is associated with irritant dermatitis, ochronosis with prolonged use, and regulatory restrictions, making it less ideal for chronic or delicate-area application.[11] Retinoids can indirectly improve pigmentation through enhanced epidermal turnover and dermal remodeling, but are often limited by their irritancy in thin periocular skin.[12] Other agents, such as kojic acid, azelaic acid, and vitamin C, are generally well tolerated but may offer slower or less robust pigment clearance and typically target fewer pathways in melanogenesis.[13] In contrast, cysteamine demonstrates multi-mechanistic activity, including tyrosinase and peroxidase inhibition, dopachrome tautomerase suppression, free radical scavenging, and iron/copper chelation, providing broader action.[7] The inclusion of isobionic-amide in combination with cysteamine further supports skin barrier repair and hydration, potentially enhancing both efficacy and tolerability.[7] Importantly, this non-hydroquinone, non-retinoid formulation showed excellent safety in our study, with only transient, mild erythema reported.

Although objective digital wrinkle analysis showed a modest increase in percentile scores from baseline to ten weeks, the change was not statistically significant. This may be due to the small sample size, short duration of treatment, or the primary mechanism targeting pigment rather than dermal remodeling. The study's small, single-center design and relatively homogenous demographic profile further limit generalizability, and the lack of a control group makes it difficult to determine the extent to which improvements were attributable solely to the treatment. Variability in participant adherence and application technique, given the self-administered nature of the treatment, may also have influenced outcomes. Moreover, the 10-week follow-up did not allow for assessment of the long-term maintenance of results, and although objective VISIA imaging was incorporated, many outcomes relied on participant self-assessment, which is inherently subjective and susceptible to bias.

CONCLUSION

Given the limitations of other brightening agents in the periorbital area, cysteamine's favorable tolerability and efficacy profile make it a compelling option for patients seeking a safe, at-home, non-invasive approach to under-eye hyperpigmentation. These preliminary findings align with existing evidence for cysteamine in facial melasma and suggest potential benefit in periorbital hyperpigmentation.[14,15] However, larger, controlled studies with more diverse populations, standardized application protocols, and extended follow-up periods are warranted to confirm its comparative efficacy and durability in the periorbital region.

DISCLOSURES

The authors have no conflicts of interest to disclose.

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ORIGINAL ARTICLE

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Clinical Efficacy of Second-Generation Tetracyclines as First-Line Systemic Agents for Gingival Lichen Planus

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ABSTRACT

Background: Oral lichen planus (OLP) patients with erythematous or erosive gingival lesions frequently fail topical therapy. The aim of this study was to determine the efficacy of minocycline and doxycycline for inflammatory and refractory gingival OLP.

Methods: In this retrospective analysis, the data of 254 patients with biopsy-confirmed OLP who displayed inflammatory gingival lesions and failed treatment with topical agents were analyzed. Patients treated between 2015 and 2023 with a 2-month course of either doxycycline 100 mg twice daily or minocycline 100 mg twice daily, concomitantly with topical agents, were included.

Results: After 2 months of treatment with doxycycline or minocycline, 60.6% patients improved with a marked reduction in erythema (95% CI 54.6%–66.6%). More specifically, in patients with mild gingival inflammation at baseline, 80.3% improved (95% CI 71.3%–89.2%) compared to 29.4% of patients with desquamative gingivitis at baseline (95% CI 16.9%–41.9%). Acute flare-ups after discontinuing therapy, which developed in approximately 25% of patients, responded to additional courses of antibiotics for 1to 2 months. Mild adverse effects were noted in 10 patients, which all resolved rapidly when the drug was discontinued.

Conclusions: This study demonstrates that both doxycycline and minocycline are highly effective agents for inflammatory gingival OLP lesions that are difficult to palliate. As these patients often fail to respond to topical agents and require more aggressive systemic drugs that are immunosuppressive with significant adverse effects, second-generation tetracyclines should be considered first-line systemic agents for inflammatory gingival OLP lesions.

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INTRODUCTION

Oral lichen planus (OLP) is a common, chronic mucosal inflammatory disease associated with T-cell-mediated immunologic dysfunction.[1] Although the buccal mucosa and tongue are the most frequent sites of involvement, gingival lesions are also especially common. In fact, up to 10% of patients have their disease confined to the gingiva.[2]

Gingival lichen planus may appear as asymptomatic, small, raised white, lacy papules or plaques, sometimes resembling keratotic diseases such as leukoplakia.[3] Gingival lichen planus most frequently presents as erythematous lesions, often accompanied by desquamation and erosions (desquamative gingivitis).[4] Erosive OLP lesions may resemble other oral inflammatory diseases, including pemphigoid, pemphigus, linear IgA disease, and foreign body gingivitis. All these disorders result in desquamative gingivitis not easily identified as lichen planus unless there are coexistent reticular lesions on the gingiva or elsewhere in the oral cavity. Because of the wide variations in the clinical appearance of gingival OLP, delay in diagnosis and misdiagnosis are frequent.[5]

The treatment of OLP is aimed at eliminating erythematous and erosive lesions, alleviating symptoms, and potentially decreasing the risk of malignant transformation. Useful agents for the treatment of gingival OLP are potent topical corticosteroids and topical immunomodulators (ie, tacrolimus, pimecrolimus, and cyclosporin), which may be used as alternatives to, or in conjunction with, topical corticosteroids.[6] In patients who fail to respond to topical agents alone or who exhibit erosive disease or desquamative gingivitis, systemic agents, including hydroxychloroquine, methotrexate, mycophenolate, azathioprine, and other immunosuppressive agents, result in significantly better results than topical agents alone, although direct comparative studies are lacking.[7] All these agents require careful monitoring for lab abnormalities, and furthermore, none produce long-term remission when discontinued.

Gingival OLP lesions, when inflamed or erosive, are especially difficult to palliate, and sensitivity and bleeding can significantly impact eating, drinking, and oral hygiene. In this retrospective analysis of patients with inflammatory gingival OLP, the response to therapy with a second-generation tetracycline antibiotic, minocycline or doxycycline, is presented.

MATERIALS AND METHODS

The records of patients treated between 2015 and 2023 with clinical evidence of inflammatory gingival OLP treated with either doxycycline or minocycline were examined. Only patients with

histologically confirmed disease were included in the analysis. Patients with OLP lesions confined to the gingiva exhibiting desquamative gingivitis also had direct immunofluorescent testing to rule out other diseases. Demographic data were collected for each patient.

Patients with gingival OLP were graded using a 3-point severity scale where 0 = no disease or white lesions only; 1= mild disease (mild inflammation with or without white lesions); 2 = moderate disease (significant inflammation with or without white lesions), and 3 = severe disease (desquamative gingivitis with or without erosions). Patients with a baseline severity score of 1 or greater were included in the analysis. Patients whose baseline gingival lesions were white and asymptomatic (severity score of 0) were not included, as they required no treatment.

All patients included in the analysis were initially treated with either potent topical steroids (betamethasone or clobetasol) alone, or in combination with a topical calcineurin inhibitor (tacrolimus or pimecrolimus), applied concomitantly, twice daily. Patients who failed this regimen and whose gingival lesions remained inflamed were then treated with either doxycycline 200 mg/day or minocycline 200 mg/day for 2 months. Patients who did not complete the 2-month course of therapy were not included in the analysis. Patients were also advised to continue all topical treatments. Improvement was defined as a reduction of the severity score by at least 1 point. Patients were followed for at least a year after the systemic agent was discontinued.

RESULTS

A total of 254 patients were included in the analysis, and their demographic features are presented in Table 1. There was a female predominance (66%) with a mean age of 56 years. Four patients treated with doxycycline and 6 with minocycline were not included in the analysis, having discontinued the drug due to mild adverse effects, most commonly, dizziness, sun sensitivity, and gastrointestinal discomfort. Symptoms in all patients resolved within days of discontinuing the drug.

TABLE 1.

Cohort Demographics	
Number of patients	254
Male:Female	34%:66%
Mean age (range)	56 (32–82)
Duration of disease	
< 1year	10 (4%)
1–3 years	139 (55%)
>3 years and <5 years	66 (26%)
>5 years	39 (15%)
Patients with symptoms (burning, stinging, pain, bleeding)	128 (50%)
Lesions confined to the gingiva	50 (20%)
Presence or history of cutaneous lesions	22 (9%)
Treated with minocycline: doxycycline	120 (47%): 134 (53%)

In 50 of the 254 patients (20%), lesions were confined to the gingiva, whereas in the remaining patients, involvement was noted in multiple sites, most commonly on the buccal mucosa and tongue.

Approximately a third of the patients had a baseline gingival severity score of 1 (n=76), 50% had a score of 2 (n=127), and 20% displayed desquamative gingivitis with a score of 3 (n=51). After 2 months of treatment with doxycycline (n=120) or minocycline (n=134), 154 of 254 (60.6%) patients improved (95% CI 54.6% –66.6%; Table 2). More specifically, gingival lesions improved in 80.3% of patients in those with mild disease at baseline (severity score 1 to 0 in 61/76 patients; 95% CI 71.3%–89.2%); 49.6% in those with moderate disease, (severity scores of 2 to 1 in 50 of 63 patients; 2 to 0 in 13 of 63patients; 95% CI 40.9%–58.3%); and 29.4% in those with severe disease (severity scores of 3 to 2 in 7/15 patients, 3 to 1 in 8/15 patients; 95% CI 16.9%–41.9%). No difference in the response to minocycline (61.9%) vs doxycycline (59.2%) was identified as agents produced nearly identical results, regardless of the severity of the disease.

Approximately 50% of all patients had symptoms from their gingival OLP lesions. Symptom severity did not appear to correlate with clinical findings. Patients with mild disease and those with severe disease had symptoms that were nearly identical.

Although not within the study design, doxycycline or minocycline anecdotally appeared to have minimal beneficial effects on OLP lesions on the buccal mucosa or tongue; most patients with these lesions were able to control the disease with more aggressive topical agents.

The majority of all patients with gingival disease were able to maintain a low level of disease activity with topical agents alone after the systemic medication was discontinued. Acute flare-ups in the first year after discontinuing therapy, which were noted in approximately 25% of patients, were treated with additional courses of antibiotics for 1 to 2 months. In almost all cases, the patient's response to therapy was comparable to their initial response.

Candidiasis, noted in less than 3% of patients treated with tetracyclines, was treated successfully with clotrimazole

TABLE 2.

Gingival Oral Lichen Planus: Response to Therapy (n=254)					
	Baseline	After 2 Months of Minocycline or Doxycycline			
Severity Score		0	1	2	3
1	76	61	15	--	--
2	127	13	50	64	--
3	51	--	8	7	36

The proportion of cases improved by treatment, *P*, for initial severity grades 1–3 are as follows: For grade 1, *P*=80.3% (95% CI 71.3%–89.2%), for grade 2, *P*=49.6% (95% CI 40.9%–58.3%), for grade 3, *P*= 29.4% (95% CI 16.9%–41.9%)

troches, 10 mg 3 to 5 times daily for 2 weeks, while patients were advised to continue their antibiotic course. Patients who did not improve with doxycycline or minocycline (n=100; 39.4%) were subsequently treated with a more potent systemic agent with potentially greater adverse effects.

DISCUSSION

The results of this study demonstrate that minocycline and doxycycline have very high clinical utility, resulting in significant improvement in disease severity in most patients treated, and should be considered a first-line systemic therapy for gingival OLP. In this study, which represents the largest study to date utilizing tetracyclines for OLP, patients with gingival disease resistant to topical therapies responded to short courses of tetracyclines with few adverse effects.

Doxycycline and minocycline demonstrate potent anti-inflammatory effects predominantly due to their inhibition of matrix metalloproteinase, protease-activated receptor 2, leukocyte chemotaxis, inflammatory cytokines, nitric oxide synthase, and the IgE pathway.[8] Since the main goal of treating OLP is to lessen the severity of local inflammation, it is likely that the benefits of these drugs in our study are due, in part, to their anti-inflammatory effects. This would also explain why doxycycline and minocycline are widely used not only for acne vulgaris and rosacea but for a variety of inflammatory dermatoses, including hidradenitis suppurativa, autoimmune bullous disorders (bullous pemphigoid and pemphigus vulgaris), various diseases resulting in cicatricial alopecia (folliculitis decalvans, dissecting cellulitis, frontal fibrosing alopecia, and lichen planopilaris), granulomatous dermatoses (sarcoidosis, granuloma annulare), and many other miscellaneous diseases.[9]

Tetracyclines are also used to treat a range of oral mucosal conditions. Both minocycline and doxycycline when used as a mouthwash or topical agent have been shown to reduce the severity and duration of pain in patients with recurrent aphthous ulceration.[10,11] Tetracycline drugs with or without nicotinamide is beneficial for the treatment of oral benign mucous membrane pemphigoid, a disease that most commonly presents as desquamative gingivitis, which can mimic OLP.[12,13] Their efficacy in the treatment of periodontitis is well established. Both the prevalence and severity of periodontal disease are significantly reduced not only by the mechanical removal of bacterial plaque (scaling and root planing) but by selective inhibition of pathogenic microflora using either systemic or, more commonly, locally applied minocycline or doxycycline.[14,15] In our study, these agents had minimal or no effects on OLP of the tongue or buccal mucosa, which suggests that the benefits of tetracyclines for gingival OLP are, in part, due to their antibacterial properties, as bacteria change the characteristics of OLP gingival lesions into more aggressive forms.[16]

Surprisingly, there have been only very sparse anecdotal data in patients with OLP treated with topical and systemic tetracyclines. Several case reports describe the efficacy of topical tetracycline for erosive oral LP.[17,18] Ronbeck and colleagues described 6 patients with gingival OLP who significantly improved with doxycycline 100 mg daily for 1 to 3 months.[19] Based upon the results of our study, tetracyclines should be employed for patients with OLP demonstrating inflammatory gingival lesions who fail to respond to topical agents. Repeated courses of minocycline or doxycycline for short periods (1–2 months) are often needed for relapses. Topical agents should always be employed concurrently and even maintained after systemic agents are discontinued.

For all OLP patients with gingival disease, it is imperative to implement an optimal oral hygiene program, as the disease can limit efficient oral hygiene maintenance by the patient, which can predispose them to develop long-term periodontal disease.[16] Although it has been suggested that symptoms associated with gingival OLP interfere with the maintenance of proper oral hygiene, enhancing the risk of periodontal disease,[20] we did not find that pain correlated with the degree of erythema and severity of the disease. All patients with inflammatory OLP gingival lesions, including those that are asymptomatic, should be encouraged to undergo frequent dental hygiene cleanings with a dentist or periodontist. The importance of maintaining an oral hygiene program that minimizes dental plaque and calculus was demonstrated in a study,[21] which resulted in significant improvement in the clinical features and painful symptoms of gingival OLP lesions, even without any medical therapy.

As with every other antibiotic class, the use of tetracyclines for the treatment of acne has led to resistance development, specifically to *Cutibacterium acnes*, the pathogenic bacterium in acne vulgaris.[22] Studies show that resistance increases with duration of acne, older age, and duration of treatment.[23] Consequently, the American Academy of Dermatology guidelines for managing acne patients recommend limiting tetracycline use to the shortest duration possible, typically no more than 3-4 months.[24] Strategies for reducing tetracycline resistance include the usage of low-dose oral doxycycline 40 mg modified-release formula. However, studies reveal that even very low-dose tetracycline antibiotics can induce the emergence of resistant bacteria.[25,26] In our study, resistance was minimized by limiting the use of tetracyclines to 2 months. In 12 patients with gingival OLP not included in the study, pulse dosing, a strategy of administering a tetracycline in acne patients for very short periods of time, 7 to 10 days, was employed. All achieved modest benefits, suggesting it may be an option for patients with milder forms of gingival OLP, although additional studies are needed to confirm these findings.

In addition to resistance, there are various other risks associated with long-term use of tetracyclines. Doxycycline use has been associated with gut dysbiosis and increased risk of irritable bowel disease and inflammatory bowel disease, as well as esophagitis, phototoxicity, and rarely, intracranial hypertension.[27] Minocycline confers similar adverse effects as doxycycline, as well as rare potential adverse effects, including vertigo, autoimmune hepatitis, skin hyperpigmentation, drug-induced lupus, and hypersensitivity syndrome.[28] Despite these potential adverse effects, tetracyclines have been widely employed for decades to treat acne and account for 75% of all oral antibiotics prescribed in dermatology.[29] In our study, only 10 patients developed mild adverse effects requiring discontinuation of the drug, which led to rapid resolution of symptoms. Oral candidiasis, noted in less than 3% of patients in this study, was likely the result of topical steroids and nonsteroidal agents used to control OLP, as the evidence supporting a link between systemic use of tetracyclines and oral candidiasis is limited. Compared to other systemic agents used to treat oral lichen planus, including corticosteroids, hydroxychloroquine, methotrexate, mycophenolate, and other immunosuppressive drugs, doxycycline and minocycline are far safer due to their lower risk of significant side effects, making them a preferable option.

Our study has several strengths, including the use of a robust population-based cohort of patients with OLP, all conformed clinically and histologically, and followed long term. Furthermore, the study accurately replicates the utilization of these drugs in a 'real world' community-based clinical setting with one examiner carefully caring for patients. There are also some limitations to our study. We did not employ any of the proposed 12 standardized scoring systems for OLP, including the Oral Disease Severity Score (ODSS), Modified White–Erosive–Atrophic (WEA-MOD), and the Reticular–Erythematous–Ulceration (REU). As others have reported, numerous factors have hampered the universal adoption of a standardized scoring system for OLP clinical trials and research.[30] In addition, we did not test the efficacy of lower doses of minocycline or doxycycline, which would potentially minimize adverse effects and resistance.

CONCLUSION

This study demonstrates that both doxycycline and minocycline are effective agents for inflammatory gingival lesions associated with OLP that are unresponsive to topical agents. Given the fact that gingival lesions are perhaps the most difficult to palliate of all OLP sites, these agents represent a relatively safe and cheap alternative to immunosuppressive agents, which are commonly employed to treat them. Minocycline and doxycycline administered for 2 months should be considered first-line therapy when a systemic agent is needed to control gingival OLP. Patients with refractory disease on oral mucosal surfaces other than the gingiva should be treated with a different systemic agent.

DISCLOSURES

The authors have no conflicts of interest to disclose.

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ORIGINAL ARTICLE

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Cosmetic Procedures for Treating Lichen Planus Pigmentosus: A Review

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ABSTRACT

Lichen planus pigmentosus (LPP) is a rare pigmentary disorder primarily affecting patients with skin of color. Currently, comprehensive evaluations for procedural interventions for LPP are limited in the literature. In this review, we assess current procedural options for LPP treatment, focusing on their efficacy, safety, and practical considerations. A comprehensive literature search using PubMed and Embase identified English studies published through December 2024 that examined cosmetic procedures for the treatment of LPP. Keywords included "lichen planus pigmentosus," "laser," "chemical peel," "glycolic acid," "salicylic acid," "TCA," "jessner," "VI," "cosmetic procedure," "procedure", and related terms. Articles without original data, sufficient results, or human participants were excluded. Data on study design, participant characteristics, procedural details, and clinical outcomes were extracted and reported in this descriptive review. A total of 16 studies were reviewed, which highlighted procedural approaches to managing LPP, including chemical peels (eg, phenol and glycolic acid), laser therapy (eg, Q-switched Nd:YAG, CO2 fractional, Picosecond Nd:YAG, erbium-doped fiber), and platelet-rich plasma therapy. Evidence was limited by small sample sizes, lack of randomized controlled trials, and reliance on case reports and series. Most studies included fewer than 20 participants, limiting the generalizability of findings. In conclusion, procedural interventions can serve as an alternative treatment option for LPP, especially for those unresponsive to standard treatments. Further research with larger cohorts and comparative trials are needed to further elucidate current findings.

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INTRODUCTION

Lichen planus pigmentosus (LPP) is a rare variant of lichen planus (LP) characterized by persistent dark brown, black, or slate gray coalescing macules primarily affecting sun-exposed areas, including the face, neck, and upper extremities.[1,2] This condition was first recognized and reported in India.[3] However, since its discovery, it has been reported in various other ethnicities with diverse skin types, including patients of Southeast Asian, Hispanic, and African descent.[4] The exact etiology of LPP remains unclear; however, it has been associated with ultraviolet radiation, hepatitis C infection, environmental pollution, and the topical application of mustard oil, henna, and hair dyes, particularly in India.[5]

LPP patients often experience significant psychosocial distress due to the cosmetic impact of the condition, further compounded by its refractory response to most treatment modalities.[6] Existing studies on treatment for LPP primarily focus on non-procedural therapies such as topical corticosteroids, calcineurin inhibitors, and systemic treatments. While these treatment strategies may potentially be effective in stabilizing the disease and preventing further progression, the residual pigmentation caused by pigment incontinence in the dermis is often resistant to conventional treatments.[7,8]

Cosmetic procedures are increasingly being used for pigmentary disorders, offering a promising alternative for LPP management.[9-11] Techniques such as laser therapy, chemical peels, and platelet-rich plasma have been used for the reduction of excess pigmentation in LPP patients.[4,8] However, existing literature on their application in LPP remains limited. This review aims to evaluate current procedural options for LPP treatment, focusing on their efficacy, safety, and practical considerations. By providing a comprehensive analysis of these treatment modalities, this paper seeks to guide dermatologists in optimizing care for patients with LPP and highlight areas for future research.

MATERIALS AND METHODS

A comprehensive literature search using PubMed and Embase identified studies examining cosmetic procedures for the treatment of LPP. Keywords used were: "lichen planus pigmentosus," "laser," "chemical peel," "glycolic acid," "salicylic acid," "TCA," "jessner," "VI," "cosmetic procedure," "procedure". English articles published until December 2024 were screened. Studies that had patients diagnosed with LPP, evaluated the use of cosmetic procedures, and reported clinical outcomes, efficacy, or adverse effects of treatments were included. Articles without human participants or lacking sufficient procedure outcomes were excluded. Reviews, editorials, and commentaries without original data were also excluded. Sixteen studies in total were included in this review. Data were systematically extracted from the included studies, focusing on the following parameters: study design, participant characteristics, procedural details of the intervention, clinical outcomes, and reported adverse effects. A qualitative analysis was performed, and results are presented descriptively. Key features of each study are reported in Table 1.

RESULTS

Chemical Peels

Chemical peeling, or chemical exfoliation, involves applying a chemical substance to the skin to induce controlled damage to the epidermis and sometimes the dermis. This promotes skin regeneration and remodeling, improving texture and appearance.[12] Chemical peels are classified by penetration depth: superficial (eg, glycolic acid (GA) 30–50%, salicylic acid (SA) 30%, Jessner solution (JS), resorcinol 25%–50%, lactic acid 10%–30%, mandelic acid 50%, pyruvic acid 50%, and trichloroacetic acid (TCA) 10%–35%, medium (glycolic acid >70%, glycolic acid 70% + TCA 35%, TCA 30–50% + JS and salicylic acid >30%), and deep (eg, TCA >50% + JS and phenol 88%).[13]

Few studies in the literature examine the role of chemical peels in LPP. A retrospective analysis done by Sonthalia et al analyzed the effect of six sessions of modified phenol peel on the reduction of LPP in Indian patients. The investigators used a modified, croton oil-free phenol preparation to diminish the risks associated with conventional phenol peels, which due to the presence of croton oil, demonstrate deep and unpredictable penetration that places individuals with darker skin types at high risk of postinflammatory hyperpigmentation. The authors describe this modified peel as medium-depth to deep.[2] In this study, 17 patients with Fitzpatrick skin types (FST) IV and V and biopsy confirmed LPP on the face, neck, and various other regions (chest, back, arms, etc) were included. The croton oil–free peel contained phenol 8%, trichloroacetic acid 15%, glycolic acid 2%, ascorbic acid, retinoic acid, and a mixture of other α- and β-hydroxy acids at 1% each. The investigators evaluated the efficacy of the peel using a non-validated pigment reduction scale. At the end of treatment, 29.4% of patients had excellent improvement (>75% reduction in pigment from baseline), in which pigmentation completely cleared from most involved areas with significant lightening in less involved regions.[2] In addition, 76.5% of patients had moderate (26–50% reduction), good (51–75% reduction), or excellent improvement of their pigmentation.[2] Adverse effects noted during the procedure included temporary burning and nasopharyngeal irritation due to phenolic odor. All patients experienced expected reactions, namely erythema, scaling, and crusting on the postpeel days 3 or 4.[2] Two patients had prolonged peel reactions and temporary postinflammatory hyperpigmentation (PIH) that resolved in 15 days with topical hydroquinone 2%.[2]

Due to the mid-to-deep dermal pigmentation in late stages of LPP, it is expected that only a medium to deep peel would be effective. However, attempts have been made to treat LPP with more superficial chemical peels. Wolff et al. reported a case involving an 18-year-old Hispanic male with LPP who was treated with Jessner's solution and glycolic acid chemical peels, in conjunction with topical retinoids.[4] After 16 weeks of treatment with glycolic acid increased from 35% to 70% over the course of six sessions, and significant improvement was observed in the facial lesions.[4] Only mild improvement, however, was noted on the forearms, where Jessner's solution was used exclusively. No adverse events were reported.[4] A prospective study of 40 patients with various facial melanoses in India compared the therapeutic effect of microdermabrasion (MDA) followed by 35% glycolic acid peel to treatment with 35% glycolic acid alone.[14] Each treatment group consisted of 20 patients. Among the participants, one patient with LPP, whose FST was not specified, demonstrated a 50% improvement with the MDA and glycolic acid peel combination. More patients receiving the combination treatment (n=9) experienced a 50–100% improvement of symptoms compared to those only treated with 35% glycolic acid (n=4). The most observed side effects in this study were intense burning and erythema, followed by pigmentation, which was usually transient.[14] Ultimately, combination therapy with MDA proved more effective than 35% glycolic acid alone.

While chemical peels have demonstrated potential in the treatment of LPP, more robust, long-term studies are needed to establish their efficacy and safety comprehensively. Standardization of protocols is particularly important to ensure the procedure's safety and effectiveness across diverse Fitzpatrick skin types. Additionally, future research should focus on identifying optimal peel concentrations, depth of penetration, application techniques, and adjunctive therapies to maximize therapeutic benefits while minimizing adverse events.

Lasers

Lasers are sources of high-intensity monochromatic coherent light indicated for multiple dermatologic conditions. Their effectiveness in treating pigmented lesions is based on

TABLE 1.

Summary of Studies Examining Dermatologic Procedures for the Treatment of Lichen Planus Pigmentosus

Citation	Study Design	Treatment Procedure	Condition	Body Parts Affected	Number of Patients	Patient Race and/or FST
Sonthalia S et al. *J Cosmet Dermatol.* 2019;18(5):1479-1486.	Retrospective Analysis	Chemical peel (phenol)	LPP	face, neck, upper chest, back, forearm	17	FST IV and V
Bhari N et al. *Dermatol Ther.* 2020;33(2):e13208.	Pilot Study	Laser Therapy (QSNYL)	LPP	head, neck, upper extremities, chest, abdomen, lower extremities, back	9	*Study conducted in India
Shah Dr SD et al. *J Cosmet Laser Ther.* 2019;21(2):108-115.	Open-label non-randomized prospective pilot study	Laser Therapy (QSNYL)	LPP	face	13	FST IV and V
Mhatre M et al. *Iran J Dermatol.* 2021;24(1)	Retrospective observational study	Laser Therapy (QSNYL)	LPP, PIH, melasma, photomelanosis, nevus of Ota, periorbital melanosis, nevus spilus, Riehl melanosis, Cafe-au-lait macules, freckles, compound nevus, Hori's nevus	face	100 * (2 of which had LPP)	Indian
Mamatha et al. 2015. Available from: https://www.semanticscholar.org/paper/Comparative-Study-on-Combination-of-with-35-Acid-35-Mamatha-Hanumanthayya/09b0d043a7f97f6a861d3a8d0bf218e27cad5efd [accessed on 1 February 2025]	Comparative Study	Chemical peel	LPP, melasma, PIH, acne, photo-melanoses	face	40 * (1 of which had LPP)	Indian
Garg S et al.[preprints.org/manuscript/202310.0539]. Accessed December 11, 2024.	Retrospective observational study	Laser Therapy (Pixel Q-switched, ablative pixel erbium YAG)	LPP, melasma, ashy dermatosis, dermal nevi, tattoos	face	122 * (11 of which had LPP)	Indian
Wolff M et al. *J Clin Aesthetic Dermatol.* 2016;9(11):44-50	Case Report	Chemical peel (glycolic acid, Jessner's)	LPP	face, neck, forearms	1	Hispanic
Belzer A et al. *JAAD Case Rep.* 2023;34:45-47.	Case Report	Laser therapy (Picosecond Nd-YAG)	LPP	face	1	Black
Kim JE et al. *J Dermatol.* 2012;39(2):189-191.	Case Report	Laser therapy (Nd-YAG)	LPP	forehead	1	Korean
Han XD et al. *Dermatol Ther.* 2014;27(5):264-267.	Case Report	Laser therapy (Nd-YAG)	LPP	face	1	Chinese
Jung CJ et al. *Ann Dermatol.* 2023;35(Suppl 1):S38-S42.	Case Series	Laser therapy (CO_2 fractional, non-ablative fractional)	LPP	chin	2	FST III and IV, Korean
Murray TN et al. *Dermatol Surg.* 2023;49(11):1046-1048.	Case Report	Laser therapy (erbium-doped fiber)	LPP	face, neck	1	FST V
Wu CY et al. *Australas J Dermatol.* 2019;60(4):e336-e337.	Case Report	Laser therapy (Picosecond Nd-YAG)	LPP	face	1	N/A
Bandali T et al. *JAAD Case Rep.* 2024;53:136-138	Case Report	Laser Therapy (QSNYL)	LPP	face, neck	1	FST IV, South Asian
Radmanesh R et al. *Iran J Dermatol.* 2020;23(3):125-128.	Case Report	Laser Therapy (CO_2 laser resurfacing)	LPP	face	1	FST III

selective photothermolysis: when a specific wavelength of light is selectively absorbed by a target chromophore, that energy can destroy its target while minimizing damage to surrounding tissue.[15] In patients with LPP, pigment and pigment-laden macrophages are predominantly observed in the papillary dermis. Q-switched Nd:YAG lasers (QSNYL) deliver high-intensity irradiation, which is preferentially absorbed by melanin particles measuring 10–100 nm in size within the skin.[15] This absorption generates a sharp temperature gradient between the melanosomes and surrounding structures, resulting in thermal expansion and selective destruction of melanosome-containing cells.[15,16] Picosecond lasers, which operate on the scale of picoseconds, deliver even faster pulses compared to Q-switched lasers, which operate on a nanosecond scale.[15] This ultrashort pulse duration further minimizes heat diffusion to surrounding tissue, potentially enhancing the precision and efficacy of pigment destruction. Subsequently, the disrupted pigment is cleared by macrophages, potentially leading to clinical improvement in LPP.[16]

Several studies and case reports have demonstrated improvement of LPP with pigmented lasers. A pilot study by Bhari et al. included 9 Indian patients with LPP who were treated with QSNYL.[17] Primary sites of involvement were the head and neck. Additional sites of involvement were the upper extremities, chest, abdomen, back, and lower extremities. A total of 6 sessions were completed at 2-week intervals for each patient. The laser parameters were: 1,064 nm wavelength, 6 mm spot size, fluence 3 J/cm^2, and 10 Hz repetition rate. After the 6th session, a mean of 25.7% clinical improvement was noted by physician assessment. The Fitzpatrick skin types of the patients were not indicated.[17] In another study by Shah et al, investigators used the standard protocol of QSNYL with a 5 mm spot size, fluence 3–4.6 J/cm^2, and 5 Hz repetition rate on 13 patients with LPP for 5 to 6 sessions.[8] Patients were of FSTs IV and V. The treatment response, measured by the clearance of pigment, was graded as follows: Grade I (<25% improvement, minimal), Grade II (26–50%, moderate), Grade III (51–75%, marked), Grade IV (>75%, good), and Grade V (>90%, almost clear).[8] All patients showed a satisfactory response to treatment, defined as Grade III or higher. 38.4% of patients achieved Grade V improvement, 38.4% exhibited a Grade IV response, and 23% showed a Grade III response.[8]

In addition to the QSNYL, there are cases of LPP treated with fractional CO_2 lasers and picosecond lasers. A case series involving two Korean women with Fitzpatrick skin types III and IV described the use of fractional laser treatments for managing LPP of the chin.[18] One patient underwent 10 sessions of CO_2 fractional laser treatment at 6-week intervals, while the other received 7 sessions of a 1,927 nm non-ablative fractional laser at 8-week intervals.[18] Both patients demonstrated marked improvement, with minor residual atrophy and clinically reduced pigmentation following their respective treatments.[18] In another report, a Black woman with LPP, whose Fitzpatrick skin type was not specified, was treated with a picosecond Nd:YAG laser on her full face with 1,064 nm wavelength for 10 total treatments, with approximately 1-month between treatments.[19] After 10 sessions, there was moderate improvement of the patients dark brown to gray macules, identified via clinical images, but pigmentation persisted.[19] The patient underwent 4 additional treatments at 785 nm which led to significant improvement of pigmentation.[19]

Reported adverse effects of laser therapy for LPP included swelling, depigmentation, scarring and PIH. Excluding these, no other major side effects were noted.

Laser therapy has shown promise as a potential alternative treatment modality for LPP. However, future studies are warranted to further develop strategies to allow for efficacious and safe use of lasers across different skin types. Additionally, future research should focus on optimizing laser parameters to minimize adverse effects and enhance therapeutic outcomes.

Platelet-Rich Plasma

Platelet-rich plasma (PRP) is an autologous blood-derived product characterized by a high concentration of platelets suspended in plasma. It is rich in bioactive molecules, including growth factors, immune system mediators, and enzymes, which collectively contribute to tissue repair and regeneration processes.[20] The proposed mechanism by which PRP targets pigmentation involves its ability to modulate melanogenesis and reduce melanin accumulation in pigmented lesions.[20] Studies have shown that PRP increases transforming growth factor-beta (TGF-β), which decreases melanogenesis and associated signaling proteins, as observed in melasma patients.[21] Evidence from clinical trials demonstrates significant reductions in melanin levels following intradermal PRP administration, with measurable decreases in modified Melasma Area and Severity Index (mMASI) scores and melanin content in treated areas compared to controls.[21] These findings suggest that PRP's effects on melanogenesis and melanin clearance may offer a promising therapeutic option for pigmentary disorders, including LPP.

An experimental pilot study conducted by Pituvong et al evaluated the effectiveness of platelet-rich plasma (PRP) for treating hyperpigmentation in patients with LPP.[22] Five patients aged 18 to 60 years, with histologically confirmed LPP and facial lesions lasting six months or longer, were included.[22] The cohort consisted of four female and one male patient, all of whom completed the treatment protocol. Their average age was 47.6 years (range 35–56 years). Among these participants, three (60%) had Fitzpatrick skin type (FST) IV, and two (40%) had FST V, with a duration of illness ranging from one to six years.[22] The patients received three PRP intradermal injections, two weeks apart, and follow-ups at two weeks, one month, and two months post-treatment.

Significant improvement in pigmentation was observed, with the mean melanin index decreasing from 450.33 ± 69.91 at baseline to 392.60 ± 73.88 after eight weeks (P<0.05).[22] A consistent reduction in the melanin index was noted after each treatment, with an overall improvement of 14.93% after two weeks.[22] Physician assessments indicated moderate improvement after three treatments, and patient satisfaction increased progressively, with "very satisfied" ratings following the second treatment. Side effects, including mild edema and bruising, resolved spontaneously with no reports of infection.

This study's efficacy demonstrates promising results though findings are limited by a small sample size and lack of placebo controls. Large-scale studies are recommended to validate these outcomes and explore the therapy's potential across Fitzpatrick skin tones. Topical PRP with or without microneedling has not been studied.

DISCUSSION

This review highlights the role of cosmetic procedures–chemical peels, lasers, and PRP in the management of LPP. Each modality has demonstrated varying degrees of efficacy, safety, and cost-effectiveness. Chemical peels involving medium to deep penetration including modified phenol peels, showed significant improvement in pigmentation with relatively mild adverse effects like temporary burning and PIH.[14] Lasers, such as the QSNYL and fractional ablative lasers, offered promising outcomes, although the results varied based on FST. Clinicians should consider administering a spot treatment first when treating higher Fitzpatrick patients to minimize risk of adverse events. PRP demonstrated potential as a safe and effective alternative but was supported by limited data.

Cost-effectiveness varied significantly depending on the procedure and resources available. PRP, while slightly more expensive due to the need for blood collection and processing, may still offer a cost-effective alternative when compared to laser therapies, particularly in clinics that already have access to the necessary equipment for PRP. In contrast, lasers like QSNYL, which require highly specialized and costly equipment, often involve higher upfront costs, maintenance, and operator expertise, which may limit their availability and affordability in low-resource environments. Total cost-effectiveness of each treatment depends on the number of sessions required for optimal results and the long-term benefits observed, as repeated treatments can increase the overall cost of some therapies.

Evidence on procedural interventions for LPP is limited by small sample sizes, lack of randomized controlled trials and reliance on case reports and series. Most studies included fewer than 20 participants, limiting the generalizability of findings. There is also a lack of direct comparative studies between procedures, making it difficult to establish treatment preferences. To address these limitations, larger, well-designed randomized controlled trials are needed to validate the efficacy and safety of cosmetic procedures for LPP. Comparative studies evaluating different modalities across various FSTs would provide clearer guidance for clinicians. Additionally, exploring combination therapies such as microneedling with PRP could optimize treatment outcomes by targeting multiple mechanisms of hyperpigmentation.

Lastly, expanding access to these procedures for conditions like LPP in resource-limited settings is crucial for addressing disparities and improving outcomes for underserved populations. In many low-income areas, limited access to advanced dermatological care can exacerbate the burden of conditions like LPP, especially among individuals with skin of color. Cosmetic procedures offer an alternative treatment modality for LPP, particularly for patients unresponsive to conventional therapies. While existing evidence demonstrates their potential, further research is essential to refine protocols, enhance efficacy, and ensure safety across diverse patient populations. By addressing these gaps, dermatologists can tailor treatments to individual needs and advance care for this challenging pigmentary disorder.

DISCLOSURES

Dr Adotama is an advisory board member/consultant with Galderma, Bristol-Myers, Regeneron, Proctor and Gamble and Janssen. The other authors have no relationships to disclose.

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ORIGINAL ARTICLE

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Pentoxifylline as a Steroid-Sparing Agent in Granuloma Annulare: A Rural Retrospective Study

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ABSTRACT

Background: Granuloma annulare (GA) is a benign inflammatory dermatosis characterized by dermal granuloma formation. While its etiology is unclear, GA has been linked to systemic comorbidities. Localized GA typically responds to corticosteroids, but generalized GA often follows a more refractory course. Pentoxifylline has emerged as a potential steroid-sparing agent, though data are limited.

Methods: A retrospective chart review was conducted on 102 patients diagnosed with GA at a single academic dermatology clinic in rural Appalachia. Demographic data, disease subtype, treatment history, and comorbidities were recorded. Comorbidity prevalence was compared with state and national averages. Statistical analysis assessed associations between disease extent, treatment response, and comorbidity burden.

Results: The cohort was 79% female with a mean age of 46 years; 19% of cases were pediatric. Generalized GA accounted for 46% of cases and showed elevated rates of type 2 diabetes (36%), hypothyroidism (26%), and autoimmune disease (15%). Patients with ≥3 comorbidities were more likely to have prolonged disease (>2 years). Generalized GA required more treatment attempts ($P<0.001$) and had higher failure rates than localized disease. Pentoxifylline achieved a 64% response rate in generalized GA, outperforming hydroxychloroquine and topical corticosteroids.

Conclusions: Generalized GA is more treatment-resistant and associated with a greater comorbidity burden. Pentoxifylline demonstrated favorable efficacy and may serve as a first-line systemic agent in refractory cases. Further multi-center studies are needed to validate these findings and guide evidence-based management of GA.

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INTRODUCTION

Granuloma annulare (GA), initially identified as a "ringed eruption of the fingers," is a benign and self-limiting inflammatory skin disorder characterized by granuloma formation in the dermis.[1] Its incidence is estimated at 0.04%, with a higher prevalence among women and adults over thirty years old.[1] The most common form of GA is the localized variant, which typically manifests as annular erythematous plaques or papules, primarily on the dorsal surfaces of the hands or feet.[2,3] Generalized GA is characterized by the presence of 10 or more widespread annular plaques and involves both the upper and lower extremities.[3,4] This study focuses on the localized and generalized forms of GA, as they represent the most frequently encountered clinical variants.

The pathophysiology of GA is hypothesized to involve a delayed-type hypersensitivity reaction, with CD4+Th1-mediated macrophage activation followed by a Th2-driven cytokine response, culminating in connective tissue degradation.[1] Both M1 and M2 macrophages appear upregulated in GA, supporting a biphasic mechanism of tissue breakdown and remodeling.[1] While the disease is histologically characterized by necrobiotic granulomas surrounded by palisading histiocytes, eosinophils, lymphocytes, and mucin deposition, its etiology remains poorly understood.[1,5] GA has been linked to systemic conditions including hyperlipidemia, autoimmune disease, and type 2 diabetes mellitus, though the latter association remains unclear.[1,3,6]

Topical and intralesional corticosteroids are considered first-line therapies, often yielding partial or complete resolution.[1] For recalcitrant or generalized disease, additional agents such as phototherapy, hydroxychloroquine, pentoxifylline, and dapsone have been explored, though response rates vary considerably.[1,7,8] More recently, systemic and targeted agents such as methotrexate, TNF-α inhibitors, and JAK inhibitors have shown promise in small case series.[9,10,11,12] However, variability in treatment efficacy, limited high-quality data, and long disease

durations continue to complicate management decisions. Pentoxifylline, a phosphodiesterase inhibitor, has emerged as a potential steroid-sparing agent used for refractory generalized GA cases, but supporting data remains sparse and largely anecdotal.

This retrospective study evaluates the treatment outcomes and comorbidity burden of GA in a rural Appalachian cohort, a population underrepresented in the dermatologic literature. Previous GA studies have primarily relied on data from large urban centers or insurance databases, which may not reflect outcomes in resource-limited or comorbidity-heavy populations, such as West Virginia. By comparing our institutional treatment data with national averages, this study aims to validate prior findings in a new demographic context, assess the real-world efficacy of multiple treatment options for granuloma annulare, and highlight pentoxifylline as a potential emerging therapy. These findings may help inform more generalizable treatment guidelines while also identifying opportunities to expand the use of cost-effective therapies, such as pentoxifylline, in underserved populations.

MATERIALS AND METHODS

This study received approval from the Marshall University Institutional Review Board for human subject research. To identify patients with GA within the Marshall Health Network, ICD-10 code L92.0 was used. A list of patient names, birth dates, visit dates, and medical record numbers (MRN) was generated. Inclusion criteria for the study required at least one clinical note documenting a GA diagnosis. Patients were excluded if they had only a pathology report without corresponding clinical documentation of diagnosis or treatment. Additionally, patients whose biopsy results disproved the suspected GA diagnosis were excluded.

Generalized GA was defined as either 10 or more lesions or involvement of at least two of the following areas: upper extremities, lower extremities, or torso. Patients who received treatment but were lost to follow-up were included in the evaluation of treatments attempted but excluded from the analysis of response rates. Chart reviews were conducted using patient MRNs to gather information on diagnosis, treatments, disease course, comorbidities, and demographics. Data were recorded in a password-protected Excel spreadsheet, and filters were applied to facilitate subgroup analysis. Data analysis was performed using Excel Toolpak, including descriptive statistics and two-sample t-tests. Figures were created with GraphPad Prism and Excel ToolPak.

RESULTS

A total of 102 patients with GA were included in the study. Of these, 46.1% (n=47) were proven by biopsy. The cohort comprised 81 females (79.4%) and 21 males (20.6%). Among generalized GA patients, 89% were female, while 70% of those with localized GA were female. The age distribution was as follows: 30.4% were under 35 years old, 34.3% were between ages 35 and 60, and 35.3% were 60 years or older. Most patients (57%) were over 50 years old, and 19% were pediatric cases. The average age overall was 46 years; it was 51 years for generalized GA and 42 years for localized GA. Over half of the patients had localized disease (n=54) while the others had generalized disease (n=47). Short-term disease (duration <6 months) was observed in 9.7% of patients, while long-term disease (>6 months and <2 years) was present in 41.9%, and prolonged disease (>2 years) was seen in 48.4%.

The most frequently used treatments were topical steroids (68%), hydroxychloroquine (21%), intralesional steroids (18%), pentoxifylline (21%), topical calcineurin inhibitors (10%), and dapsone (7%). Less commonly used treatments (<3%) included methotrexate, doxycycline, niacinamide, mycophenolate mofetil, sulfasalazine, and phototherapy. Colchicine, minocycline, and isotretinoin were included in the study but were not reported in any patients.

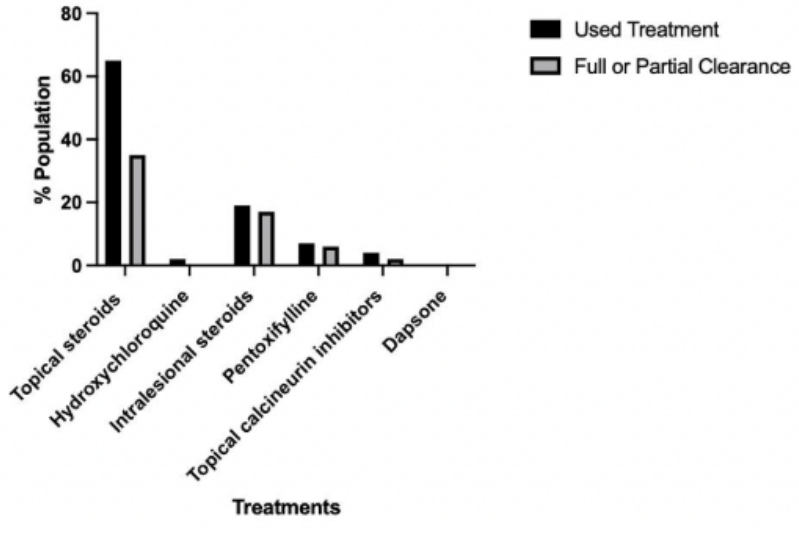
Generalized GA patients had significantly more treatments tried (P=0.002) and failed (P=0.00031) than those with localized GA. Over half (55%) of generalized GA patients failed at least one treatment, while 26% failed two or more. In contrast, 22% of localized GA patients failed at least one treatment, and only 6% failed two or more (Table 1).

TABLE 1.

Treatment Use and Clearance Outcomes in Granuloma Annulare, Stratified by Disease Subtype

Treatment	Used (Overall GA)	Clearance (Overall GA)	Used (Localized GA)	Clearance (Localized GA)	Used (Generalized GA)	Clearance (Generalized GA)	Used (Prolonged GA)	Clearance (Prolonged GA)
Topical Steroids	68%	59%	65%	61%	87%	51%	70%	54%
Hydroxychloroquine	21%	43%	2%	0%	43%	45%	39%	47%
Intralesional Steroids	18%	72%	19%	90%	23%	50%	27%	60%
Pentoxifylline	21%	67%	7%	75%	36%	64%	27%	67%
Topical Calcineurin Inhibitors	10%	50%	4%	100%	17%	43%	11%	75%
Dapsone	7%	57%	0%	--	15%	57%	14%	50%

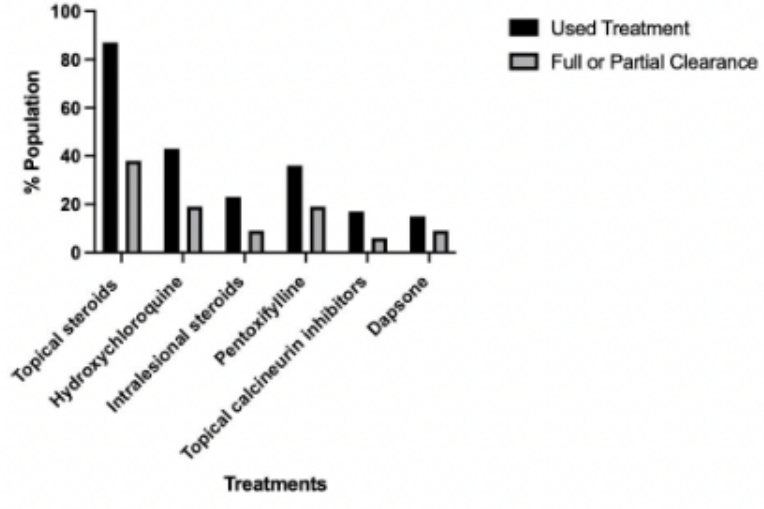
FIGURE 1. Treatment use and response in localized Granuloma Annulare



Bar graph showing treatment frequency and response rates in localized GA
Topical steroids were most used, with intralesional steroids and calcineurin inhibitors showing the highest clearance rates among alternatives.

The most successful treatments in localized disease were intralesional steroids and topical calcineurin inhibitors (Figure 1), used in 19% and 4% of patients, respectively. Topical steroids were the most used and had a response rate of 61%. For generalized GA, the most successful treatments were pentoxifylline (64% success rate) and dapsone (57% success rate), which were used in 36% and 15% of patients, respectively (Figure 2). The most used treatments in generalized GA were topical steroids (51% response rate) and hydroxychloroquine (45% response rate). In comparison, hydroxychloroquine was used more often in generalized GA (43%) than localized GA (2%) and with a higher success rate. The most successful treatments in prolonged GA were topical calcineurin inhibitors and pentoxifylline, which were used in 11% and 27% of patients, respectively. The most used treatments in prolonged GA were topical steroids (54% response rate) and hydroxychloroquine (47% response rate).

FIGURE 2. Treatment use and response in generalized Granuloma Annulare.



This bar graph shows the percentage of patients with generalized GA who received specific treatments and the proportion of patients who achieved full or partial clearance. Topical steroids were most frequently used but had modest success. Pentoxifylline and dapsone demonstrated higher clearance rates among systemic therapies, highlighting their potential utility in treatment-resistant cases.

TABLE 2.

Prevalence of Comorbidities Among Patients with Granuloma Annulare Compared With State and National Averages

Treatment	WV State Average	Overall GA	Localized GA	Generalized GA
Smoking history	21%	29%	20%	38% (^17%)
T2DM	17%	32% (^15%)	30% (^13%)	36% (^19%)
HLD	41%	41%	33%	49%
Hypothyroidism	12%	26% (^14%)	22% (^10%)	26% (^14%)
Eczema	9%	6%	4%	9%
Cancer	14.0%	12%	7%	17%
Autoimmune disease	5%	14% (^9%)	13% (^8%)	15% (^10%)
Anxiety	38%	41%	43%	38%
Depression	28%	35%	37%	32%

Comorbidity prevalence is also shown. National data were used for hypothyroidism and autoimmune disease,[13,14] and West Virginia-specific data for all others.[15,16-19]
Eczema data reflect patients aged ≤17,[16] and anxiety rates represent symptoms reported with combined depressive disorder.[17]
HLD, hyperlipidemia; T2DM, type 2 diabetes mellitus.

HLD and anxiety were the most common comorbidities, each affecting 41.2% of GA patients (Table 2). Generalized GA patients had significantly more comorbidities than those with localized disease (P=0.04), with higher rates of HLD, smoking history, and T2DM, up to 18% more.

Patients with prolonged GA had more comorbidities than those with shorter disease durations (mean 2.6 vs 1.8; P=0.02). Among those with prolonged disease, 60% had generalized GA and 40% had localized GA. Additionally, 55% of patients with prolonged disease had three or more comorbidities, compared to only 27% with shorter duration.

DISCUSSION

This study highlights the therapeutic challenges of granuloma annulare (GA), particularly in its generalized form, due to variable clinical presentations and treatment responses. Demographic findings were consistent with prior literature, showing a 4:1 female predominance and mean age of 46 years. Generalized GA had a higher average age (51 years) and greater female predominance (9:1). Notably, pediatric cases comprised 19% of the cohort, exceeding previous reports of 5%.[20]

Comorbidity analysis revealed hyperlipidemia (HLD) and anxiety as the most common conditions in GA patients (41.2% each). Depression, type 2 diabetes mellitus (T2DM), and smoking history were also prevalent. While anxiety rates were like the general population, contradicting Belzer et al[21], HLD and smoking were more frequent in generalized GA, consistent with prior findings.[20,22] Smoking history was 17% higher than state or national averages (Table 2), supporting its potential role in GA pathogenesis via cytokine-mediated granuloma formation.[23,24] Compared to population data, rates of T2DM, hypothyroidism, and autoimmune disease were notably increased, particularly in generalized GA. Increases in localized GA were 13% (T2DM), 10% (hypothyroidism), and 8% (autoimmunity), while generalized GA showed higher elevations of 19%, 14%, and 10%, respectively (Table 2), aligning with findings by Yousaf et al.[25] These patterns suggest a possible severity-dependent relationship between GA and these comorbidities.

Localized GA responded well to topical and intralesional corticosteroids, consistent with their role as first-line therapies. Second-line agents such as pentoxifylline and topical calcineurin inhibitors also showed benefits. Pentoxifylline demonstrated a 64% response rate, aligning with prior reports of 66% efficacy, while calcineurin inhibitors showed a 50% response rate, comparable to previous studies (54%).[1,26]

Generalized GA was more treatment-resistant, with patients requiring significantly more treatment attempts compared to those with localized disease (P<0.001). Topical corticosteroids were less effective in generalized GA (51% vs 61%), while pentoxifylline and dapsone demonstrated relatively higher efficacy rates (64% and 57%, respectively). Pentoxifylline, though still under investigation, is thought to exert TNF-α blocking effects, thereby inhibiting macrophage activation and reducing disease severity.[27] While previously supported mainly by case reports and small case series, this study adds to the limited data by providing a real-world response rate of 64% in 21 patients, supporting its potential as a first-line systemic agent in generalized GA.[27,28]

In prolonged cases (≥2 years), pentoxifylline (67%) and topical calcineurin inhibitors (75%) were the most effective agents. Though hydroxychloroquine was the most frequently used alternative (39%), it had the lowest success rate (47%) and poses risks such as irreversible retinal toxicity, requiring ophthalmologic monitoring.[29] These findings again reinforce the utility of pentoxifylline as a viable long-term option.

Beyond physical symptoms, GA imposes a considerable psychological burden. In this study, 55% of patients with generalized GA required more than one treatment due to therapeutic failure. The chronic, refractory nature of GA can result

in patient frustration and decreased quality of life. Continued research is needed to identify more effective therapies and improve long-term outcomes.

Limitations include the retrospective design, potential documentation bias, and single-center sampling, which may limit generalizability. Future prospective, multi-center studies with diverse populations and randomized treatment arms are warranted to validate findings and optimize care for patients with GA.

CONCLUSION

In conclusion, GA predominantly affects females and older adults, with generalized disease showing stronger associations with type 2 diabetes, hypothyroidism, and autoimmune conditions. These findings support the utility of screening for diabetes and thyroid dysfunction and maintaining clinical vigilance for underlying autoimmune disease. Notably, having three or more comorbidities was associated with prolonged disease duration, offering potential prognostic value.

Localized GA responded well to first-line therapies, while Generalized GA was more treatment-resistant. Among all therapies evaluated, pentoxifylline demonstrated the highest success rate in generalized GA, highlighting its potential as an emerging, well-tolerated treatment option. Pentoxifylline also showed favorable outcomes in patients with prolonged periods of disease. These findings underscore the need for future multi-center studies with larger, more diverse populations to confirm efficacy and help refine treatment guidelines.

DISCLOSURES

The authors declare no conflicts of interest.

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ORIGINAL ARTICLE

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Racial Disparities in United States Clinical Trial Enrollment for Mycosis Fungoides and Sézary Syndrome

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ABSTRACT

Background: Racial disparities in clinical trial enrollment can limit the generalizability of therapeutic data, which is particularly damaging for conditions that disproportionately impact minority patients, such as mycosis fungoides and Sézary syndrome.
Objective: To characterize the racial demographics of mycosis fungoides/Sezary syndrome (MF/SS) clinical trials and explore potential barriers to enrollment for Black patients in the United States (US).
Methods: We searched the terms "mycosis fungoides," "Sezary syndrome," "CTCL," and "Cutaneous T-Cell Lymphoma" on ClinicalTrials.gov. Interventional trials that were completed with results posted and had at least one site within the US were included. We assessed racial demographics, trial enrollment proportions relative to 2023 US Census data, geographic access, exclusion criteria, and race-based reporting practices.
Results: A total of 1483 participants across 27 trials were characterized, 154 (10.4%) of whom identified as Black. Compared to population data from the 2023 US Census, Black patients were significantly underrepresented ($P<0.001$) in MF/SS trials overall, overrepresented in Phase 1 trials ($P=0.013$), and underrepresented in Phase 3 trials ($P<0.001$). Most trial sites (69%) were in areas with moderate (12.6–49.9%) to high (≥50%) Black populations. There were no significant differences in exclusion criteria between low- and high-Black-enrolling trials. Of 36 trial-related publications identified, only 14 (39%) reported participant race.
Conclusions: The findings of this study reveal significant racial disparities in MF/SS clinical trial enrollment. Identifying these disparities and investigating barriers to enrollment ensures that MF/SS patients of all racial backgrounds are appropriately represented at each phase of the experimental process.

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INTRODUCTION

Retrospective analyses of clinical trial research over the last two decades have revealed that minority enrollment is lacking across all medical specialties, and efforts to increase representation have historically been limited.[1,2] Moreover, prior studies have suggested that Black patients are disproportionately over-enrolled in early-phase clinical trials assessing safety and underenrolled in later-phase trials that evaluate efficacy, limiting their access to potentially life-saving treatments and contributing to persistent disparities in clinical outcomes.[2]

A lack of equitable inclusion of racial and ethnic minorities in clinical trial research is particularly relevant for conditions like mycosis fungoides (MF) and Sézary syndrome (SS), where significant racial disparities exist in disease incidence, presentation, and outcome. According to Surveillance, Epidemiology, and End Results (SEER) data from 2000 to 2018, the incidence ratios of MF and SS are higher in Black individuals compared to their White counterparts (6.50 and 4.92 vs 0.45 and 0.17, respectively).[3] Black patients are also diagnosed at an earlier age and more advanced stage, experience greater total body surface area involvement, face a higher risk of secondary complications, and have significantly poorer survival outcomes, even after adjusting for disease characteristics, socioeconomic factors, and treatment modalities.[4-8]

Previous studies have sought to characterize racial and ethnic participation in CTCL clinical trial research, however they utilized median percentages across trials to evaluate representation, did not analyze potential barriers to enrollment, or excluded Phase 1 clinical trials from their analyses.[9,10] The aim of our study was

multifold: we sought to characterize the racial demographics of US-based MF/SS clinical trials relative to 2023 US Census data, explore geographic access and exclusion criteria as potential barriers to enrollment, and analyze race-based reporting practices of trial-related publications identified in the literature.

The US National Library of Medicine clinical trials database (ClinicalTrials.gov) was queried on October 17, 2024, to identify all-phase clinical trials in MF/SS using the terms "mycosis fungoides," "Sezary syndrome," "CTCL," and "Cutaneous T-Cell Lymphoma." Trials were included if they were US-based, marked as complete, and had racial data publicly available for extraction. Statistical analyses were conducted to compare enrollment proportions to 2023 US Census data, both overall and stratified by trial phase.

Similar to a study by Okeke et al that examined minority enrollment in hidradenitis suppurativa clinical trials, we assessed the geographic accessibility of MF/SS trials by comparing trial site locations to 2023 US Census data (www.census.gov/quickfacts).[11] Sites were categorized based on their Black population density as follows: very low (≤5%), low (5–12.5%), moderate (12.6–49.9%), and high (≥50%).

Trials were stratified into low (≤12.5%) vs high (>12.5%) Black enrollment groups. We then evaluated exclusion criteria to identify potential differences between groups. Criteria were categorized into five domains: comorbidities, organ function thresholds, laboratory value cutoffs, immunocompromised status, and other.

To assess reporting of racial data in publications, we used several approaches: searching National Clinical Trial (NCT) numbers on PubMed, performing advanced PubMed searches combining principal investigator names with the terms "mycosis fungoides" and/or "Sézary syndrome" from the trial registration year onward, and reviewing the "Publications" tab on ClinicalTrials.gov. Retrieved publications were examined for mention of racial demographics in the main text, tables, or supplementary materials. Trials were categorized as either reporting or not reporting race.

Primary statistical analyses compared the representation of Black participants in clinical trials overall and stratified by phase vs the proportion of Black individuals reported in the 2023 US Census. Group differences between studies with low (≤12.5%) and high (>12.5%) Black participant enrollment were also assessed. All categorical comparisons were performed via chi-square (χ^2) tests using statistical packages in RStudio statistical software. Given the exploratory nature of the study, no adjustments for multiple comparisons were applied, and no covariates were controlled. $P<0.05$ was considered statistically significant.

Of the 316 trials initially identified, 27 met the inclusion criteria. These trials enrolled a total of 1,483 participants with available racial data. Approximately two-thirds of the study cohort were male (60.4%), consistent with the known gender distribution of MF in the general population. Most participants identified as White (76.2%) and non-Hispanic/Latino (90.4%), while only a small proportion identified as Black or African American (10.4%). All included studies were interventional in design and a combined majority were Phase 2 and 3 trials (70.4%). A detailed summary of participant demographics and trial characteristics is provided in Table 1. Stratification by trial phase revealed a significant overrepresentation of Black participants in Phase 1 trials (32.9%, $P=0.013$) and underrepresentation in Phase 3 trials (6.76%, $P<0.001$; Figure 1). Most trial sites (69%) were in cities with moderate or high Black population density (Figure 2). No significant differences in exclusion criteria were observed between trials with low vs. high Black enrollment (Table 2). Lastly, among 36 identified trial-related publications, only 14 (39%) reported racial data (Table 1).

The results of our analysis revealed a persistent representation gap in trial participation for Black patients, despite well-documented disease disparities that disproportionately impact this group. Notably, significant differences in Black enrollment by trial phase support the notion that minority populations may be overexposed to early-phase experimental therapies, where safety data is limited, yet underrepresented in later-phase trials that seek to establish efficacy. Taken together, these findings mirror earlier observations in oncology clinical trials published in 2004 and 2014, suggesting that despite increased attention to trial diversity and a more demographically diverse US population, meaningful progress in equitable trial representation remains limited.[12,13]

Accessibility of trial sites and exclusion criteria of later-phase clinical trials have previously been proposed as potential barriers to minority enrollment overall, though our findings suggest that these variables do not seem to account for the underrepresentation of Black patients in MF/SS clinical trials research. Importantly, while historical abuses such as the US Public Health Service Syphilis Study at Tuskegee have contributed to narratives around medical mistrust and hesitancy, emerging research demonstrates that Black patients are no less willing than their White counterparts to participate in clinical research when offered the opportunity.[14,15] Indeed, it is likely an interplay of factors at the interpersonal, institutional, and systemic levels working in tandem to preclude minority groups from participating in clinical trial research.

The underrepresentation of Black patients in late-phase MF/SS trials has practical consequences for both clinical care and scientific integrity. A lack of diverse trial cohorts limits

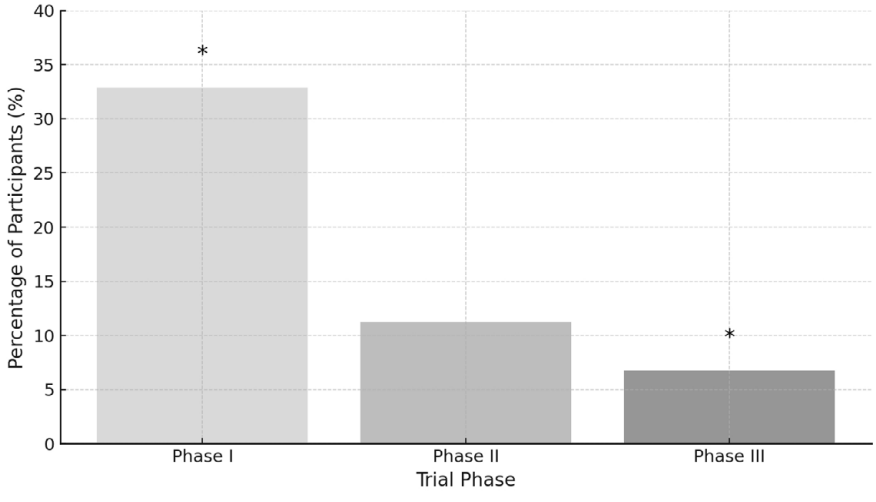
TABLE 1.

Characteristics of Included Mycosis Fungoides and Sézary Syndrome Clinical Trials and Associated Publications
This table presents the key characteristics of US-based clinical trials for mycosis fungoides and Sézary syndrome registered on ClinicalTrials.gov, including demographic information, trial phase, and trial type. Information on race-reporting in associated publications is also provided. These include any publicly available articles identified by the study team as originating from or referencing the respective trial. Some trials had multiple associated publications identified, while others had none.

Sex	# of participants (%)
Total # of Participants that Reported Sex	1483
Female	588 (39.6)
Male	895 (60.4)
Ethnicity	**# of participants (%)**
Total # of Participants that Reported Ethnicity	868
Hispanic or Latino	53 (6.1)
Not Hispanic or Latino	785 (90.4)
Other/Unknown	30 (3.5)
Race	**# of participants (%)**
Total # of Participants that Reported Race	1483
American Indian or Alaskan Native	1 (0.1)
Asian	41 (2.8)
Native Hawaiian/Other Pacific Islander	0 (0)
African American/Black	154 (10.4)
Caucasian/White	1130 (76.2)
Multiracial	0 (0)
Other/Unknown	157 (10.6)
Phase	**# of trials (%)**
Phase 1	8 (29.6)
Phase I	16 (59.3)
Phase 3	3 (11.1)
Type of Trial	**# of trials (%)**
Interventional	27 (100)
Observational	0 (0)
Trial Reportings	**# of trials (%)**
# of Trials that Reported Sex	27 (100)
# of Trials that Reported Ethnicity	21 (77.8)
# of Trials that Reported Race	27 (100)
# of Trials that Reported FST	1 (3.7)
Total # of Trial Participants	1483
Trial Related Publications	**# of trials (%)**
Total # of Publications Identified	36
# of Publications that Reported Race	14 (39)
# of Publications that Did Not Report Race	22 (61)

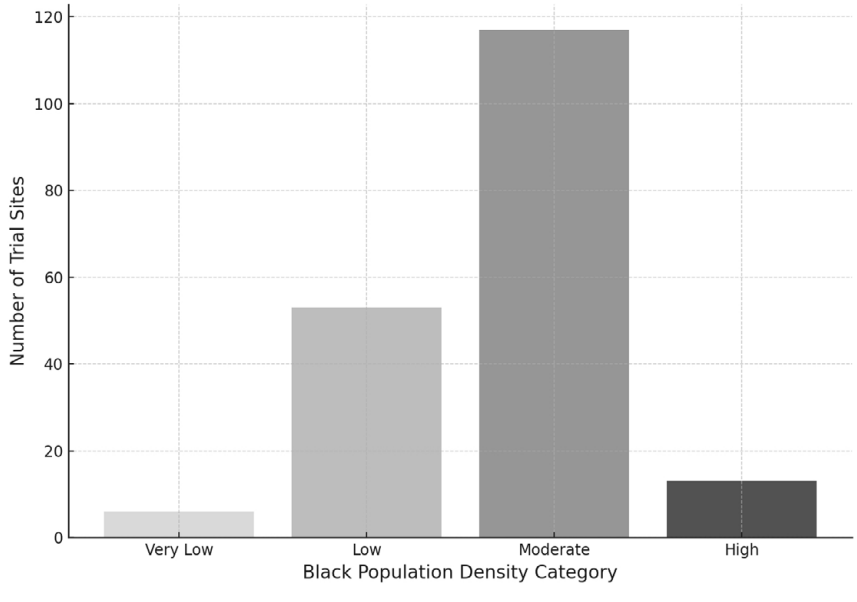
Abbreviations: #, number.

FIGURE 1. Black enrollment by trial phase in mycosis fungoides and Sézary syndrome trials.



Bar graph displaying the percentage of Black participants enrolled in clinical trials for mycosis fungoides and Sézary syndrome, stratified by trial phase. Enrollment in Phase 1 (32.9%) and Phase 3(6.76%) trials differed significantly from expected US Census representation ($P<0.05$). Enrollment in Phase 2 trials (11.25%) was not significantly different. Asterisks indicate statistically significant differences.

FIGURE 2. Distribution of mycosis fungoides and Sézary syndrome trial sites by local Black population density.



Bar graph displaying the number of mycosis fungoides and Sézary syndrome clinical trial sites (n = 189) categorized by the percentage of Black residents in the trial site's city. Population density categories were defined using 2023 US Census data as follows: Very Low (<5%), Low (5–12.5%), Moderate (12.6–49.9%), and High (≥50%). Site counts by category were: Very Low (n = 6), Low (n = 53), Moderate (n = 117), and High (n = 13).

the generalizability of efficacy data, may obscure important differences in treatment response or adverse event profiles, and risks perpetuating inequities in access across innovative therapies. Dermatologists and oncologists rely on clinical trial evidence to guide care, and if trial populations do not reflect the populations most affected by a disease, treatment decisions may be less effective when applied in a real-world setting.

Our study also reveals underreporting practices in trial-related publications that limit transparency regarding representativeness in studies pertaining to MF/SS. The democratization of data on minority enrollment in clinical trials provides a framework for accountability and creates transparency that will allow clinicians and researchers to assess whether the populations most affected by disease are included in the research that ultimately guides treatment.

TABLE 2.

Frequency of Selected Exclusion Criteria in Mycosis Fungoides and Sézary Syndrome Clinical Trials Stratified by Black Enrollment
This table presents the number of trials using each exclusion criterion, stratified by Black enrollment (low <12.5% vs high ≥12.5%). Chi-square analysis found no significant differences comparing the frequency of each criterion between enrollment groups.

Comorbidities	All Trials (n)	Low Enrollment (n)	High Enrollment (n)
Major organ dysfunction	5	3	2
History of cardiovascular disease	3	1	2
History of emphysema or COPD	2	1	1
History of non-infectious pneumonitis	2	1	1
Active autoimmune disease	10	6	4
History of autoimmune disease	5	2	3
Organ Function Thresholds	**All Trials (n)**	**Low Enrollment (n)**	**High Enrollment (n)**
Creatinine	16	2	14
Creatinine clearance	10	3	7
AST/ALT	16	3	13
Bilirubin	14	2	12
Ejection fraction	5	1	4
DLCO	4	1	3
Lab Value Cutoffs	**All Trials (n)**	**Low Enrollment (n)**	**High Enrollment (n)**
Hgb	6	1	5
ANC	14	2	12
WBC	6	2	4
Platelet	15	2	13
Albumin	2	0	2
Immunocompromised Status	**All Trials (n)**	**Low Enrollment (n)**	**High Enrollment (n)**
HIV Positive (regardless of control)	13	4	9
Hep B positive (regardless of activity)	6	3	3
Hep C positive (regardless of activity)	5	3	2
Other	**All Trials (n)**	**Low Enrollment (n)**	**High Enrollment (n)**
ECOG Score or KPS limit	17	6	11
Ability to read/understand English	1	0	1
Advanced stage disease	6	3	3
History of prior treatment for MF/SS	1	1	0

Abbreviations: MF: Mycosis fungoides, SS: Sézary syndrome; COPD: Chronic obstructive pulmonary disease, DLCO: Diffusion capacity of the lungs for carbon monoxide; Hgb: hemoglobin; ANC: absolute neutrophil count; WBC: white blood cell count; HIV: human immunodeficiency virus; Hep B: Hepatitis B; Hep C: Hepatitis C; ECOG: Eastern Cooperative Oncology Group; KPS: Karnofsky Performance Status; #: Number.

Dermatologists are often directly responsible for the diagnosis and management of patients with MF and SS and are thus uniquely positioned to advocate for more inclusive research with respect to this condition. Clinicians can play a critical role by educating patients about ongoing trials, facilitating referrals, and collaborating with trial sponsors to design studies that better reflect real-world populations. These efforts are especially needed in MF/SS clinical trials, given that race has significant implications across the entire disease trajectory.

This study has several limitations. First, our search may not have captured all MF/SS clinical trials, particularly those registered under broader cutaneous T-cell lymphoma categories or conducted outside of the US registry system. Second, while we restricted inclusion to trials with US study sites, some also enrolled participants internationally. The inability to stratify participant-level data by geographic location may have impacted the overall racial distribution in a way that limits the accuracy of our US-specific analyses. Importantly, however,

our decision to compare enrollment proportions to US Census data rather than SEER estimates, which suggest approximately 15% of MF/SS patients are Black, reflects a more conservative approach that lowered the threshold for what was considered appropriately inclusive, potentially offsetting this effect. Third, the relatively small number of included trials and specific exclusion criteria limited our ability to draw conclusions about differences in enrollment owed to trial design. Fourth, our reliance on publicly reported data may have introduced reporting bias, as race was not consistently reported across all trials or in trial-related publications. Finally, our assessment of trial-related publications was not systematic in nature and thus may not have included all articles of relevance to our study. Taken together, these limitations highlight the need for more standardized and transparent reporting of demographic data in clinical trial research.

Understanding and addressing barriers to inclusion leads to increased minority enrollment in clinical trials, which in turn ensures that consumers of drugs seeking federal approval across all racial backgrounds are included in the process of evaluating drug efficacy. While we recognize that a blanket call for increased minority representation in clinical trials oversimplifies a deeply complex issue, there must be a concerted emphasis on equitable representation-ensuring that minority patients are appropriately enrolled across all trial phases. As physicians, we bear responsibility both in clinical practice by referring patients to trials and as investigators by designing inclusive studies and transparently reporting race and ethnicity data, particularly in diseases such as mycosis fungoides and Sézary syndrome that are known to disproportionately affect underserved populations.

DISCLOSURES

The authors have no conflict of interest to declare.

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Review of Laser Therapy for Burn Injuries and Considerations for Burns in the Military Population

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ABSTRACT

Background: Nearly 500,000 individuals seek care for burns every year in the United States. Almost one burn injury occurs every day among US service members during deployment. Severe burns can result in contractures, limiting the range of motion and affecting the ability to perform daily activities.

Objective: We aimed to characterize the use of lasers in the treatment of burn injuries and to describe burn injuries in the military population.

Methods: A systematic review was conducted of the literature using PubMed to find articles pertaining to burn injuries in the military population and the use of laser therapy for burn injuries.

Results: Forty articles were included. Types of laser used for the treatment of burn injuries included CO_2 ablative fractional lasers, pulsed dye lasers, Erbium YAG lasers, and others. Laser therapy shows potential use for treating chronic contractures resulting from burn injuries. Significant improvements have been reported in reducing contractures and enhancing functionality, particularly among our service member population.

Conclusion: Trauma dermatology is a growing field that includes the treatment of burn scars in both the military and civilian populations. Laser treatments show efficacy in treatment for burn-related contractures limiting mobility and for scarring.

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INTRODUCTION

Nearly 500,000 individuals seek care for burns yearly in the United States, with 40,000 requiring inpatient care and over 3,000 dying from burn injuries yearly.[1] An average of 308 burn injuries per year occur in US service members during deployment – almost one burn injury daily.[2] The majority of these injuries are sustained from improvised explosive devices (IED) resulting in burn scars. Military personnel who served our country and suffered from disfiguring trauma scars have difficulty assimilating into the civilian workplace, and need complex medical care.

Pathophysiology of Scarring and Contractures From Burns

Superficial burn injuries, first-degree epidermal injuries, or superficial dermal injuries, leaving dermal accessory structures intact, will heal by re-epithelialization. Re-epithelialization results in minor scarring, although it frequently causes dyspigmentation.

Deep dermal or full-thickness burns destroy epidermal structures so that the wounds cannot re-epithelialize; with wounds that remain open for 2 or 3 weeks. Fibroblasts and myofibroblasts migrate into the wound starting the first few days after injury, helping the wound to contract and close. This results in contractures and hypertrophic scars.

Hypertrophic scarring from burns results in a disequilibrium between collagen production and degradation, with increased contraction resulting from the activation of the tissue growth factor-beta (TGF-β) pathway causing remodeling and scar formation.[3] This disequilibrium leads to decreased elasticity and increased dermal thickness that produces disfigurement, dysfunction of the skin, dysesthesia, and pruritus.[4] Severe burns can result in contractures that limit the range of motion and adversely affect the ability to perform daily activities.

Traumatic Burns and Considerations in the Military Population

Complex limb trauma, including amputation with prosthetic-limb interface complications, salvaged limb scarring, web contracture of hand digits, and hypertrophic scarring, dramatically limits the ability to function in daily life.

Overview of Laser Therapy

Paradigms for the treatment of traumatic scars have improved over the past decade and are motivated largely by the integration of laser technology. Lasers have emerged as a first-line therapy in the management of traumatic scars.

Laser modalities for scar therapy include fractional ablative and non-ablative lasers. Non-ablative lasers have shorter recovery times but less clinically noticeable results after a session than ablative lasers, which result in the removal of the epidermal layer.

Ablative lasers include ablative fractional carbon dioxide laser ($AFCO_2L$), ablative types of Erbium-doped yttrium-aluminum-garnet (Er:YAG) lasers, and combination modalities. The mechanism of action for ablative fractional therapy is more complex, with temperatures reaching in excess of 100° C causing fractionated columns of epidermis and dermis to be vaporized and creating microscopic full-thickness wounds. Remodeling after ablative lasers is started by regrowth of the epidermal compartment followed by healing of ablated zones of dermal collagen. In scar rehabilitation, there is histologic evidence of the re-creation of dermal epidermal ridges as in normal skin.[5] This process improves skin tightness and smoothness as the epidermis heals and regrows.

Non-ablative lasers or light sources include pulsed dye laser (PDL), intense pulsed light, and non-ablative types of erbium lasers. Non-ablative devices deliver less thermal energy (usually < 70° C) and work by coagulation of collagen. This thermal damage leads to an increased expression of heat shock proteins, which activate epidermal stem cells to proliferate and replace damaged tissue. Non-ablative vascular lasers target hemoglobin in the dermal microvasculature; the resulting tissue hypoxia and collagen fiber heating cause dermal collagen realignment and neocollagenesis.[6]

Assessment of Laser Therapy

Various scoring systems, such as the Vancouver Scar Scale (VSS) or the Manchester Scar Scale (MSS), have been used to assess the efficacy of lasers.

The VSS has been widely used in the literature for outcome results in various burn studies of patients with scarring. Four characteristics are used – vascularity, height, pliability, and pigmentation – and each of these is given a score between 0 and 13.

The MSS numerically assesses scars based on clinical, photographic, and histological features. The attributes analyzed are VSS plus scar color, skin texture, relationship to surrounding skin, texture, margin size, and multiplicity.

MATERIALS AND METHODS

A systematic review was conducted using PubMed for articles pertaining to burn injuries in the military population and the use of laser therapy for burns. The query resulted in 435 articles. Clinical trials and prospective and retrospective studies were included. Review articles, non-English articles, nonrelevant articles, and articles pertaining to children were excluded. 81 articles matched the initial search terms, with 40 articles included in review after application of these exclusion criteria. References of included studies are in Supplemental digital content 1. PRISMA diagram is shown in Figure 1.

RESULTS

Forty articles were included, 4 of which focused exclusively on the use of lasers as therapy in burn injuries in the US military (Table 1). $AFCO_2L$ is the most common laser type, followed by PDL. An overview of the steps of CO_2 laser therapy is shown in Figure 2.

Laser Therapy for Burn Injuries in the Military

In a randomized controlled trial (RCT) of 25 cases at the US Army Institute of Surgical Research Burn Center, patients were randomized to receive either PDL, $AFCO_2L$, or both for 3 treatment sessions.[7] Treatment with $AFCO_2L$ or PDL showed a statistically significant decrease from visit 1 to 3 in the Patient and Observer Scar Assessment Scale (POSAS). Thick scars (≥0.3 cm) showed a significant decrease in thickness between visits 1 and 2, with all laser modalities ($AFCO_2L$ + PDL, P=0.01; CO_2, P=0.02; PDL, P=0.03); the differences between PDL, $AFCO_2L$, and combination were not clinically meaningful. Results supported the use of laser therapy for hypertrophic burn scars, particularly in the military setting.

A prospective study using ultrasound evaluating scar thickness in the treatment of hypertrophic burns with $AFCO_2L$ in 21 patients at a US Army medical center found that scar thickness decreased over the treatment course (P<0.001).[8]

In a report of traumatic burn scars, $AFCO_2L$ 10,600 nm was used. Just 3 days after initial treatment, the patient noted significant improvement in itching, scar pliability, and range of motion. The authors also describe the use of $AFCO_2L$ to treat multiple traumatic burn scars over 8 years at the Naval Medical Center.[9]

A report of 2 cases of traumatic burn scars used $AFCO_2L$. One case showed excellent improvement in range of motion (ROM) 5 weeks after a single treatment; a combined approach of surgical contracture release followed by laser was used. In the other case of a burn scar injury from an IED, after 2 laser treatments, the patient reported incremental improvements in ROM and functionality of the remaining digits.[10]

FIGURE 1. Search query for laser therapy for hypertrophic burn scars.

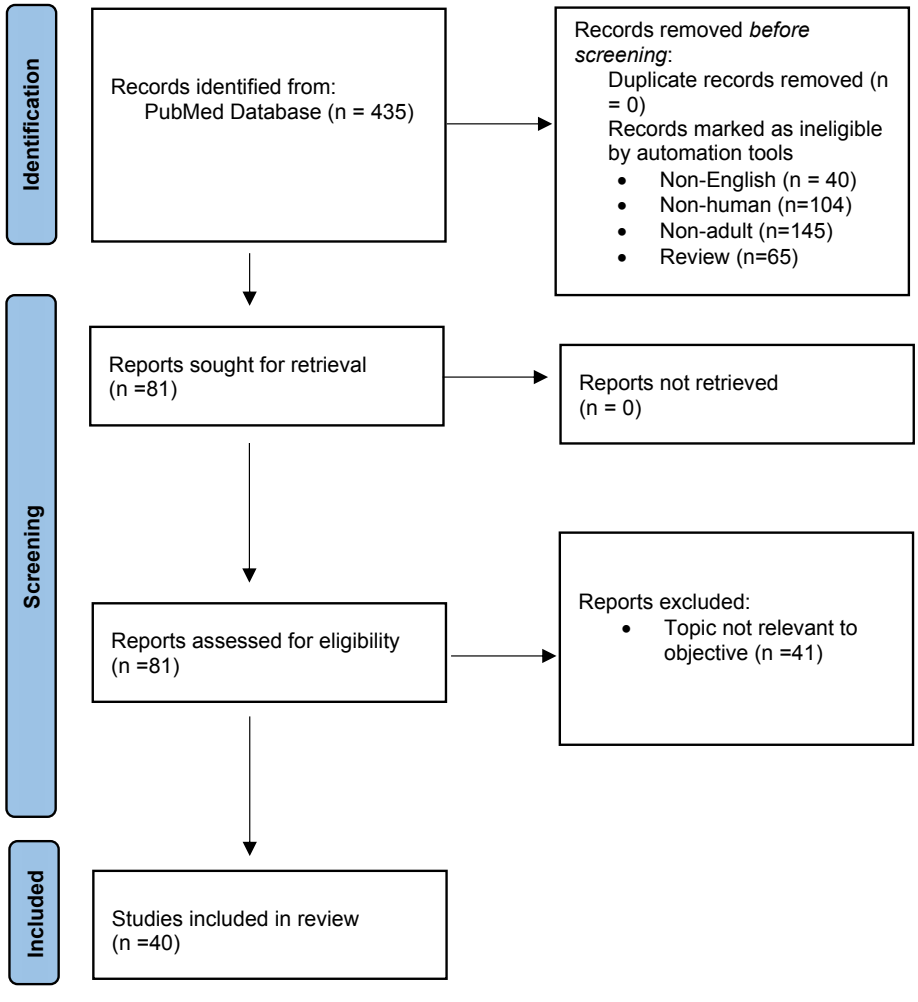
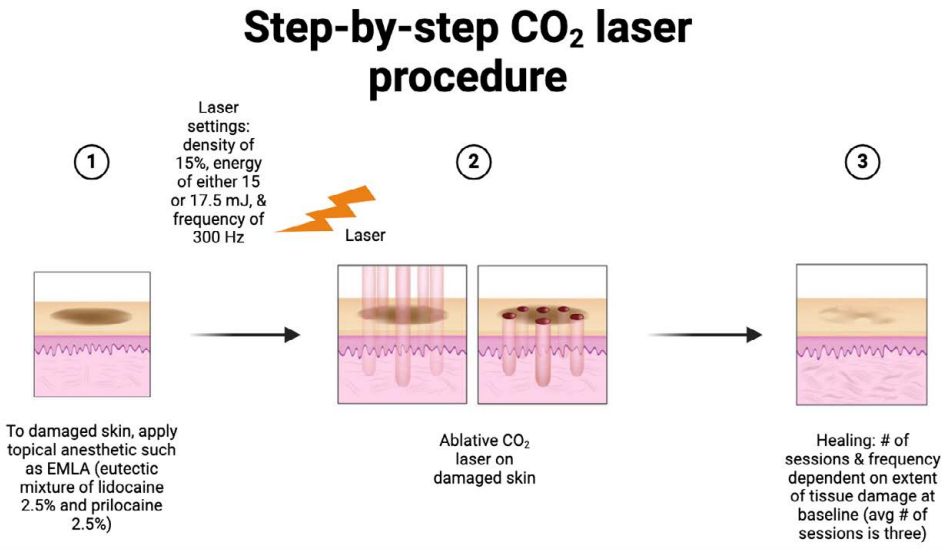


TABLE 1.

The Use of Lasers for Burns in the Military					
Study	**Laser Type**	**Condition Treated**	**Study Design**	**# Cases (n)**	**Outcome**
Cooper et al 2022[7]	$AFCO_2L$ and PDL together and separately	Hypertrophic burn scars at a US Army Military Burn Center	RCT	25	Hypertrophic burn scars treated with $AFCO_2L$ or PDL showed statistically significant decrease in Patient and Observer Scar Assessment Scale score from visit 1 to 3
Kemp et al 2021[8]	$AFCO_2L$	Hypertrophic burn scars at a US Army Medical Center	Prospective	21	Scar thickness decreased over the treatment course ($P<0.001$)
Burns et al 2017[9]	$AFCO_2L$	Traumatic burn scars at a U.S. Naval Medical Center	Case report/review	1	3 days after initial treatment, noted significant improvement in itching, pliability, and range of motion
Uebelhoer et al 2012[10]	$AFCO_2L$	Traumatic burn scars at a US Naval Medical Center	Case report review	2	Surgical contracture release followed by $AFCO_2L$ resulted in significant functional improvements compared with baseline

$AFCO_2L$, ablative fractionated carbon dioxide laser; PDL, pulsed dye laser; RCT, randomized control trial.

FIGURE 2. Overview of steps of CO_2 laser procedure.



We reported that a veteran referred from plastic surgery after extensive contracture surgeries for a burn injury (Figures 3, 4) had suffered for 19 years prior. After $AFCO_2L$, he reported significant improvement in the range of motion with opening/closing of both hands and thumb grip strength. He demonstrated decreased stiffness with decreased contracture of the palmar hands (Figures 5 to 8) and improved hand opening and grasping. He reported marked improvement in the functionality of his bilateral hands, with additional improvement reported after each session.

FIGURES 3 AND 4. Marked contractures of burn scarring are visualized in bilateral dorsal (Figure 3) and especially palmar (Figure 4) hand surfaces before laser therapy.





Ablative Fractional Carbon Dioxide Laser Therapy

CO_2 laser is an ablative laser modality showing efficacy in the treatment of burn scars. Analysis of scar collagen subtype profile after treatment with ablative fractional laser has shown improvement, with results resembling nonwounded skin.[5]

FIGURES 5 AND 6. Improved hand opening and decreased contractures are visualized in right (Figure 5) and left (Figure 6) palmar hands following ablative fractional carbon dioxide laser therapy.





FIGURE 7. Before and after improvements in scar contractures noted with arrows.



FIGURE 8. Improved hand opening and further decreased contractures seen after most recent laser treatment.



A prospective study using $AFCO_2L$ in 29 patients with hypertrophic burn scars found significant objective improvements in elastic stretch, elastic recovery, extensibility, and thickness. Patient- and physician-reported scar appearance and pain/pruritus were also significantly improved.[11] An RCT of 19 patients with moderate-to-severe acute burn injuries treated with $AFCO_2L$ found that, upon blinded assessment, 100% of treated vs control photographs were identified correctly.[12] There was a 63% average improvement in MSS vs control ($P<0.001$). No related adverse events were found. A study of $AFCO_2L$ for joint contractures treated with laser for a mean of 2.27 sessions reported improved ROM by an average of 19.13° in 6 months, yielding functional improvement in scar contractures.[13]

A retrospective study analyzing 387 $AFCO_2L$ procedures for burn scars reported overall patient satisfaction with lasers of 96.7%; patients reported decreases of 49.0% in pruritus, 50.6% in contracture, and 54.0% in neuropathic pain.[14]

Pulsed Dye Laser Therapy

PDL is hypothesized to improve hypertrophic burn scars via targeting the red chromophore within hemoglobin and thereby altering the scar microvasculature, resulting in improvement in vascularity and pigmentation.

A prospective, assessor-blinded study of 45 Asian patients with immature hypertrophic scars was composed of 22 patients in the PDL group and 23 in the control group.[15] The study found that after 3 months of 3 PDL sessions at 4-week intervals, there was statistically significant improvement of scar vascularity, pigmentation, color, thickness, and overall scores on POSAS. Scar erythema and blood perfusion also improved significantly in the PDL group and not in the control group.

Comparisons and Combinations of Laser Therapy

In a single-blinded, prospective, RCT of $AFCO_2L$ with PDL vs each treatment alone for burn scars, significant improvement of VSS, scar vascular bed, scar color, scar height, and scar pliability was found in all groups.[16] The group receiving combination therapy with PDL and $AFCO_2L$ had the most improvement. While the difference between solo treatment groups was not statistically significant, the authors believe that the VSS improvement may be clinically significant.

Combination of PDL and $AFCO_2L$ resulted in a statistically significant decrease in plasma levels of matrix metalloproteinase-2, tissue inhibitor of metalloproteinase-1, and alpha-1 type I collagen; these levels were higher prior to treatment compared with controls.[17] Reduction of these levels was hypothesized to correlate with reduction in scar dynamic, and improvements were reported in scar texture, function, color, and pruritus.

Other Laser Therapies

Other lasers besides $AFCO_2L$ and PDL have been examined in the treatment of burn injuries, including fractionally ablative Er:YAG laser, non-ablative fractional 1540 nm Erbium Glass laser, non-ablative fractional 1550 nm erbium doped fiber laser, and fractional laser resurfacing. One study of 12 patients receiving fractionally ablative Er:YAG laser treatments had significant improvement in VSS.[18] In another trial, 17 patients who received the non-ablative fractional 1540 nm Erbium Glass laser treatments showed significantly more even and smooth skin compared with adjacent untreated control sides.[19] Another study with non-ablative fractional Erbium glass laser treatment in 20 patients found an 82% improved scar texture.[20]

Use of the Neodymium-doped yttrium aluminum garnet (Nd:YAG) laser is increasing, including use of the Q-switched mode. A study comparing the picosecond Nd:YAG laser with $AFCO_2L$ found comparable results in scar erythema, texture, and height, and pain during treatment, with some superiority in hyperpigmentation with the Nd:YAG laser.[21] Nd:YAG used in Q-switched mode (1064 nm and 532 nm) has the advantage of treating the superficial layer of skin with the shorter wavelength in addition to the deeper layer, and may be used in darker skin tones.[22]

DISCUSSION

Selection of Laser Type

A brief summary of some advantages and disadvantages of the most common laser types used for hypertrophic burn scars is shown in Table 2.

Considerations in Skin of Color

Patients with Fitzpatrick skin type III and higher are at increased risk of dyspigmentation after lasers.[23] PDL also carries a risk of hyperpigmentation in this population. Ablative lasers (including $AFCO_2L$ and Erbium:YAG) are advised against in

TABLE 2.

Laser Types Used for the Treatment of Hypertrophic Burn Scarring

Laser Type	# of Cases	Advantages	Disadvantages	Considerations in Skin of Color
$AFCO_2L$	234	Improves collagen subtype profile Decreases scarring contractures, improves range of motion More extensive clinical effects after each use than with non-ablative lasers	Longer recovery time than non-ablative lasers because ablative laser removes epidermis	Further studies needed
PDL	60	Targets red chromophore in hemoglobin to alter scar microvasculature Decreases erythema and hyperpigmentation Non-ablative (Less thermal burn and shorter recovery time than ablative laser)	Purpura results temporarily from treatment Results of PDL not as dramatic as $AFCO_2L$ due to non-ablative nature of PDL	Caution or avoidance in Fitzpatrick skin type III or higher due to risk of hyperpigmentation
Erbium*	57	Targets small areas for high precision	Results of non-ablative types of erbium lasers not as marked as in ablative lasers	Risk of hyperpigmentation in skin of color
Nd:YAG	16	Small areas targeted with pico laser for high precision If used with Q-switch mode, capable of reaching superficial layers in addition to deep layers Least likely to result in dyspigmentation in skin of color	1064nm wavelength does not target superficial layers Consider risks to deeper anatomic structures within depth of laser penetration	Nd:YAG is the most recommended laser type in Fitzpatrick III and higher
Combinations of lasers	27	Achieving multiple benefits from various laser types for additive effect	Difficult to elucidate in individual cases how much of effect is derived from laser types on their own	Use only recommended laser types for patient's skin tone

*Including Erbium:YAG laser, non-ablative fractional Erbium Glass laser, non-ablative fractional erbium doped fiber laser.
$AFCO_2L$, ablative fractionated carbon dioxide laser; PDL, pulsed dye laser; Nd:YAG, neodymium-doped yttrium aluminum garnet.

Fitzpatrick skin types V and VI to avoid risk of post-inflammatory hyperpigmentation.[24] A study of 12 patients with melasma and Fitzpatrick skin III or IV found that $AFCO_2L$ was well-tolerated, with one reporting hyperpigmentation, which necessitates further studies of $AFCO_2L$ and skin of color. Nd:YAG remains a recommended laser for skin of color with a low propensity to induce dyspigmentation.[25]

Adverse Events of Laser Therapy

In one study of 544 $AFCO_2L$ sessions for hypertrophic burn scars, adverse events (AEs) were reported in 2.4%, epidermal sloughing or blistering were reported in 0.7%, and increased erythema was reported in 0.6%.[26] In another study of 163 laser sessions for hypertrophic burn scars with PDL in 71%, $AFCO_2L$ in 22%, and other lasers in 7%, pain was reported in 37%, mild blistering was reported in 27%, hypopigmentation in 12%, fever in 10%, rash in 7%, hyperpigmentation in 2%, and infection in 2%.[27] Pain and blistering were most common after PDL treatment, and post procedure pain was most common after $AFCO_2L$ treatment. Blistering and hypopigmentation were more common in higher Fitzpatrick skin types. There is one case report of reactivation of oral herpes simplex after 2 sessions of $AFCO_2L$ for a perioral burn scar.[28] Major AEs were noted as occurring exceedingly rarely in laser therapy.

Burn Injury Statistics and Burns in the Military Population

Occupational burn injuries are the second most common type of burn injury admitted to a burn center after burn injuries occurring at home.[1] Burns sustained in military deployment are often devastating and more severe than those occurring in the civilian setting.[1] The mortality rate for burns sustained during military service has been reported at 5% for those sustained in combat and 2% for non-combat burn injuries; additionally, combat injuries resulted in a greater full-thickness burn area.[29] A study of military burn injuries sustained during deployment from 2001 to 2018 found that 2,507 deployed service members sustained 5,551 burns, with blasts accounting for 82% of injuries, attributed largely to IEDs.[4]

Psychosocial Effects of Burn Injuries

Long-term psychosocial effects commonly accompany burn scarring, resulting in impairments in quality of life (QoL) in addition to negative effects on mental health.[30] Chronic contractures and disability from burns have been common contributors to depression and mental health disease in combat veterans.[31] Improvement of appearance and functionality in these injuries through optimal treatment can translate to significant improvements in QoL.

Limitations

This study's limitation is the inconsistent reporting of laser settings and treatment intervals and limited direct laser comparisons.

CONCLUSION

Lasers have utility for scarring and contractures from burn injuries. Significant improvement has been reported in functionality after laser therapy, including for burns sustained in military settings.

DISCLOSURES

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CASE REPORT

Journal of Drugs in Dermatology

Dual IL-17A/F Blockade for Acrodermatitis Continua of Hallopeau: A Clinical Response to Bimekizumab

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ABSTRACT

Acrodermatitis continua of Hallopeau (ACH) is a rare, localized variant of pustular psoriasis that primarily affects the distal digits and nail apparatus, often presenting with recurrent pustules, nail dystrophy, and significant functional impairment. Due to its rarity and chronic relapsing course, ACH is notoriously difficult to treat, and standardized treatment guidelines are lacking. We present the case of a 67-year-old male with ACH who failed multiple therapies, including corticosteroids, topical tapinarof, and oral deucravacitinib, before achieving rapid and sustained improvement with bimekizumab, a monoclonal antibody targeting interleukin-17A and IL-17F. Within one month of initiating bimekizumab, the patient experienced marked clinical improvement in both skin lesions and joint pain, with continued progress allowing him to return to work. This case highlights the potential utility of dual IL-17A/F inhibition in neutrophil-dominant pustular conditions such as ACH. As more case reports document favorable outcomes, bimekizumab may emerge as a valuable treatment option for patients with refractory ACH, offering targeted cytokine blockade in a condition with few effective therapies.

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INTRODUCTION

Acrodermatitis continua of Hallopeau (ACH) is a rare, localized variant of pustular psoriasis. Fewer than 200 cases have been reported in the literature. It is characterized by recurrent, tender, sterile pustules with underlying erythema affecting the distal digits, typically with consistent involvement of the nail apparatus.[1] Complications can include onychodystrophy leading to anonychia, as well as osteolysis of the distal phalanges.[1] The condition follows a chronic, relapsing course and is often recalcitrant to conventional therapy. Management is particularly challenging due to the lack of standardized treatment guidelines, largely stemming from the rarity of ACH.

While several case reports have demonstrated success with therapies commonly used in plaque psoriasis,[1] an increasing number of cases have reported promising responses to bimekizumab.[2-4] Here, we present a case of a 67-year-old male with ACH who responded to bimekizumab after failing treatment with deucravacitinib. This case adds to the growing body of evidence supporting bimekizumab,a dual IL-17A and IL-17F inhibitor, as a therapeutic option for ACH.

CASE PRESENTATION

A 67-year-old male presented in 2024 with a several-month history of pain, inflammation, and a rash involving the distal digits of both hands and his left foot. He reported progressive difficulty performing manual work as a motorcycle mechanic due to swelling and joint discomfort localized to the fingertips. Initial treatment with doxycycline, mupirocin, and oral terbinafine was ineffective.

His past medical history was significant for type 2 diabetes mellitus and hypertension. Current medications included dapagliflozin, pantoprazole, lisinopril, and extended-release saxagliptin/metformin.

On physical examination, several fingers and the lateral toes of the left foot exhibited erythematous, scaling plaques with nail dystrophy and subungual pustules. Nail involvement was prominent, with multiple fingernails and the lateral two toenails of the left foot affected.

A shave biopsy of an active lesion on his left index finger was performed, and laboratory testing, including a comprehensive

FIGURE 1. Baseline presentation of right thumb following treatment failure with deucravacitinib and topical tapinarof. Note coalescent, subungual pustules, nail dystrophy, and surrounding erythema.



FIGURE 2. Right thumb one month after initiation of bimekizumab. Marked resolution of erythema and clearance of pustules are observed, with residual nail dystrophy remaining.



metabolic panel, lipid panel, and tuberculosis test, was performed and found to be unremarkable. The patient was started empirically on a prednisone taper.

Histopathologic examination revealed subcorneal and intracorneal aggregates of neutrophils with parakeratosis, absence of the granular layer, and spongiosis. The findings were consistent with pustular psoriasis. Special stains, including PAS, GMS, HSV I/II, and *T. pallidum*, were all negative.

Despite partial symptomatic improvement with corticosteroids, symptoms quickly recurred following completion of the steroid taper. A trial of topical tapinarof and oral deucravacitinib was initiated. At follow-up one month later, the patient reported no perceived improvement and continued to experience functional impairment. He continued to remain on his trial of topical tapinarof and deucravacitinib at that time.

In the setting of worsening symptoms, failure of both topical and oral therapies, and prominent subungual pustulosis (Figure 1), the patient was transitioned from deucravacitinib to bimekizumab, a monoclonal antibody targeting interleukin-17A and 17F. The patient continued to use topical tapinarof as adjunctive therapy.

At one-month follow-up, the patient reported marked improvement in both his skin (Figure 2) and joint pain. After two months of therapy, he reported significant functional gains and had resumed work as a mechanic. Continued clinical improvement was noted through subsequent visits, and the patient successfully transitioned to the maintenance dosing phase of bimekizumab (every 8 weeks) after 16 weeks of therapy.

DISCUSSION

Acrodermatitis continua of Hallopeau (ACH) is rare and notoriously difficult to treat, largely due to its chronic relapsing nature and the absence of standardized treatment guidelines. Historically, therapies have been adapted from treatment regimens for other forms of psoriasis, including topical and systemic corticosteroids, vitamin D analogs, fluorouracil, calcineurin inhibitors, coal tar preparations, systemic retinoids, cyclosporine, methotrexate, and phototherapy.[1] Similarly, in our case, the patient was initially managed with corticosteroids, topical tapinarof, and deucravacitinib, none of which resulted in sustained clinical improvement. These negative outcomes are consistent with prior reports of therapeutic resistance in ACH and underscore the pressing need for more effective, targeted options.

In ACH, dysregulation of IL-36, Th17 cells, neutrophils, and keratinocytes leads to elevated IL-17 cytokine levels, which in turn drive neutrophil recruitment.[2] Consequently, IL-17-targeted therapies have emerged as promising options in the management of pustular psoriasis subtypes, including ACH. Bimekizumab, a monoclonal antibody that inhibits both IL-17A and IL-17F, may offer superior efficacy compared to IL-17A inhibition alone. Our patient's rapid improvement after transitioning to bimekizumab supports the notion that dual cytokine blockade may be particularly effective in neutrophil-dominant disease presentations such as ACH. Experimental studies have demonstrated its ability to normalize IL-36 expression, a key inflammatory driver in pustular psoriasis, to levels seen in non-lesional skin.[4] These findings provide a biologic rationale for the growing number of case reports supporting bimekizumab as a therapeutic option in pustular variants of psoriasis.

As biologics have become increasingly central in the treatment of psoriasis and its subtypes, attention has shifted toward their role in managing ACH. A review by Wang et al of published pustular psoriasis cases found that anti-TNF-α agents were the most frequently reported, with IL-12/23 and IL-17A inhibitors also demonstrating efficacy.[5] Notably, our case is among the few to describe successful treatment of ACH with bimekizumab, a dual IL-17A/F inhibitor that was not included in that review. This gap

highlights the need for continued reporting of successful cases, particularly those involving biologics with broader cytokine blockade.

Our case adds to this emerging literature, demonstrating rapid and sustained improvement of ACH with bimekizumab in a patient who failed both corticosteroids and deucravacitinib. It further supports the expanding role of dual IL-17A/F inhibition as a viable treatment strategy for refractory cases of ACH.

CONCLUSION

This case contributes to the expanding evidence base supporting bimekizumab as a treatment for ACH. As our understanding of pustular psoriasis pathophysiology deepens, targeted biologics with broader cytokine inhibition may offer new hope for patients with treatment-resistant forms of the disease. Ongoing documentation and investigation will be crucial in guiding future therapeutic strategies for this rare and challenging condition.

DISCLOSURES

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CASE REPORT

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Amelioration of Dominant Dystrophic Epidermolysis Bullosa Ulceration by Combination Gentian Violet and Trichloroacetic Acid Therapy

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ABSTRACT

Introduction: Dominant dystrophic epidermolysis bullosa (DDEB) is a hereditary genetic disorder with a mutation of the type VII collagen gene (COL7A1), leading to a destabilized dermal-epidermal junction. Current treatments for DDEB are supportive, and new gene therapies are being developed to target DDEB. However, gene therapy can be expensive.

Case Report: A 59-year-old woman presented with eroded blisters on her right lower extremity. Genetic testing identified a pathogenic COL7A1 mutation, confirming the diagnosis of DDEB. She was treated with 6 weeks of gentian violet and trichloroacetic acid peel, resulting in significant improvement of her lesions.

Discussion: DDEB is characterized by dysregulated inflammation of chronic wounds and aberrant fibroblast activity. Gentian violet and trichloroacetic acid may address inflammation while reducing fibroblast activity and preventing infection. The treatment worked well for the patient, and there was minimal pain with the application of these topical therapies.

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INTRODUCTION

Dominant dystrophic epidermolysis bullosa (DDEB) is a hereditary genetic disorder with a mutation of the type VII collagen gene (COL7A1), resulting in a defect of anchoring collagen VII (Col VII), which stabilizes dermal-epidermal adhesion.[1] Consequently, patients with DDEB experience skin blisters and fragility. Most clinical consequences of DDEB result from delayed wound healing, aberrant skin remodeling, and chronic inflammation.[2]

Currently, clinical management for DDEB focuses on supportive treatment and trauma avoidance.[1] Patients may undergo skin transplant or surgical repair of complications that develop from scarring following epidermal injury, such as mitten hand deformities.[1] Biological treatments such as dupilumab have been studied for controlling itch in patients with pruritic subtypes of DDEB.[3] Emerging treatments in gene and stem cell therapy show promise in clinical application, while new advancements in bioengineered skin substitutes promote local wound healing.[1]

We report a case of a patient with DDEB lesions of the lower extremity treated with gentian violet (GV), a small molecule with both anti-inflammatory and antibacterial properties, with trichloroacetic acid (TCA) to enhance GV penetration into cutaneous tissue.[4] Over the course of 6 weeks, the patient's wounds demonstrated substantial healing, reepithelialization, and recovery.

CASE REPORT

Our patient, a 59-year-old woman, presented with eroded blisters on her right lower extremity. She was told she had a genetic blistering disease with lifelong effects, especially on the lower extremities. She had no family history of blistering disease. Prior to her office visit, she had treated her blisters and wounds with supportive measures, including dressings to reduce friction. Based upon the presence of scarring, location, and morphology of the blisters, and absence of family history, we felt that a diagnosis of a dominant dystrophic epidermolysis was likely. Genetic testing was performed to determine whether she would be eligible for gene therapy with Vyjuvek (beremagene geperpavec).

Genetic testing showed that the patient was heterozygous in the COL7A1 gene for a pathogenic c.6235G.A substitution, which has been reported in patients with DDEB, confirms the diagnosis.

FIGURE 1. Lesion site of patient with DDEB (A) before treatment with eroded and flaccid blistering and (B) after 6 weeks of treatment with 1% gentian violet and 50% TCA



However, Vyjuvek was denied by her insurance. Because of this, we opted to treat her for 6 weeks with one coat of 50% TCA on affected skin immediately followed by application of 1% gentian violet.[4] The patient did not notice pain upon application of TCA directly to the ulcers. The treatment was applied every two weeks in the office, and she also applied gentian violet twice weekly at home. After 6 weeks of treatment, the lesional skin showed significant improvement (Figure 1).

DISCUSSION

Recently, gene therapy has been utilized in the treatment of epidermolysis bullosa,[1] and overexpression of wild-type Col VII could potentially ameliorate the phenotype of DDEB by outcompeting mutant Col VII. However, permanent correction has not been definitively accomplished and may require multiple expensive treatments. Of interest, while each keratinocyte contains a pathogenic mutation causing DDEB, the phenotype in this patient manifested itself on the extensor surface of the leg. This implies that additional factors are required for full-fledged expression of the ulceration phenotype. The additional factors that promote the full phenotype present an opportunity for therapeutics. Localized inflammatory stromal changes in DDEB likely contribute to ulcer formation, and it is possible that the combination of gentian violet and TCA may promote reversion to a nonulcerative stroma. Advantages of this treatment include ease of administration and expense. The patient did not notice pain upon application of TCA directly to the ulcers. GV and TCA may also promote wound healing through advantages in antimicrobial action, as well as controlling inflammation and fibrosis.

Controlling the inflammatory stage of chronic DDEB wounds is crucial in facilitating wound healing. Increased activity of elastase and matrix metalloproteinase in chronic wounds acts as a counterforce to growth factors and extracellular matrix that try to remodel epidermis in the wake of disrupted dermal-epidermal junction.[5] Inflammation also disrupts keratinocyte differentiation needed to restore the skin barrier at wound sites, and extended inflammation can lead to fibrosis or hypergranulation instead, leading to complications of DDEB such as mitten hand.[2,6] Aberrant activated fibroblast activity may also contribute to dysregulated stroma in lesional DDEB.[7]

Treatment with GV and TCA may synergize to ameliorate ulceration in DDEB through reducing inflammation and fibroblast activity.

GV has the effect of reducing inflammatory expression that is present in lesional DDEB skin. Other cutaneous disorders characterized by aberrant inflammation, such as palmoplantar psoriasis, have shown robust response to GV therapy, and previous case reports have documented GV suppressing granulation tissue in patients with non-Herlitz junctional epidermolysis bullosa with subsequent wound reduction.[4,8]

In one particular mechanism, increased inflammation in DDEB may be mediated by activation of the T helper (Th) 1, 2, and 17 pathways. Transcriptomes of DDEB skin versus healthy skin have shown increased transcription of GATA3+ Th2 cells in affected skin.[3] Nuclear factor kappa B (NF-kB) is one key mediator in the activation of GATA3+ Th2, and GV inhibits NF-kB via decreasing oxidation of inhibitor of nuclear factor kappa B (IkB).[9,10] Thus, GV may contribute to dampening GATA3+ Th2 inflammation expressed in lesional DDEB skin. Dupilumab treatment reduced GATA3+ Th2 expression in DDEB, reducing pruritus and the itch-scratch-blister cycle of DDEB, and GV may have a similar effect, targeting the same inflammatory culprits.[2,3]

Additionally, studies investigating GV use on chronic wounds have highlighted other advantages of GV as a wound dressing. Aside from low cost, GV effectively decreases superficial bacterial burden as a wound dressing, especially against gram-negative bacteria.[11]

TCA has been shown to decrease collagen and matrix metalloproteinase synthesis in fibroblasts, and has been used clinically to reduce scarring in conditions such as acne.[12,13] Lesional DDEB has a stroma that is over-fibrotic, leading to a disorganized skin barrier, and as such, intermittent application of TCA in the patient may have reduced this fibrotic effect.

Overall, the regional application of GV and TCA to wounds of patients with DDEB could help modulate the aberrant inflammatory profile found in lesional skin. In addition, it creates a supportive environment for healing and acts as an antimicrobial to prevent infection and inflammatory responses to bacteria. This case highlights the topical application of this inexpensive dressing as an effective method for promoting healing in DDEB lesions.

One limitation of this study is the difficulty in assessing progress on DDEB wounds, given their tendency to heal, recur, and then

re-heal.[5] Therefore, evaluating healing at one time point does not necessarily mean the success of an intervention. However, there was no ulcer recurrence at her site at her follow-up appointment a month following the end of treatment, whereas re-ulceration is typical. In addition, previous conservative treatment had not yielded improvement in this patient, providing evidence that this intervention helped ameliorate her ulcers.

DISCLOSURES

The authors have no conflicts of interest to disclose. Patient Consent: The authors obtained written consent from patients for their photographs and medical information to be published in print and online, and with the understanding that this information may be publicly available.

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BRIEF COMMUNICATION

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GLP-1 Receptor Agonists in Overweight and Obese Patients With Hidradenitis Suppurativa

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INTRODUCTION

Hidradenitis suppurativa (HS) is a chronic, multifactorial inflammatory disease that is influenced by obesity and metabolic dysfunction. Overweight and obese individuals may experience more severe HS due to increased skin folds and body surface friction.[1] Furthermore, metabolic dysfunction, which drives pro-inflammatory states, has also been implicated in HS pathogenesis.[1] While weight reduction and improvements in metabolic state have been associated with disease amelioration, current evidence regarding the specific benefits of glucagon-like peptide-1 receptor agonists (GLP1-RAs) in HS is limited to a few studies.[1-4]

This IRB-exempt retrospective study analyzed electronic medical records of adult patients seen at the University of Pennsylvania between 01/01/2019–12/31/2023 with a diagnosis of HS (ICD-10 L73.2) and concomitant body mass index (BMI) ≥27kg/m^2 with at least one weight-related comorbidity (diabetes, hypertension, and/or hyperlipidemia) or BMI ≥30kg/m^2.[5] All patients with ≥2 HS dermatology appointments and GLP-1RA use during the study period were included. HS disease activity was defined by treating clinicians' documentation and is reported as improvement, no change, or worsening disease. The chi-square tests evaluated categorical variables. Wilcoxon rank sum test assessed associations between clinical parameters (weight change, age at HS diagnosis, GLP-1RA duration, BMI, and hemoglobin A1c [HbA1c]) and HS disease activity.

Of 425 HS patients identified, 142 (33.4%) met the inclusion criteria. Demographics and HS clinical characteristics are outlined in Tables 1 and 2. 44.4% (n=63) of patients had a documented Hurley stage at the initial visit, of which 57.1% (n=36) had stage II-III disease. Most patients (83.8%, n=119) were not receiving GLP-1RA therapy prior to their initial HS appointment. The average duration of GLP-1RA therapy from its initiation to the most recent HS visit was 564.2 days (range: 14–2905). Improvement of HS was experienced by 59.9% (n=85) of patients, while 30.3% (n=43) had no change in disease activity, and 9.9% (n=14) experienced worsening. Baseline BMI was 41.1kg ± 8.8, and HbA1c was 6.7 ± 2.2. Patients who improved vs those with no change or worsening disease were more likely to experience a higher degree of BMI reduction (BMI change: -6.2kg ± 13.5 vs -0.4kg ± 13.8, P=0.01). No association was found between age of HS diagnosis (P=0.68), GLP-1RA duration (P=0.98), baseline BMI (P=0.46), or baseline HbA1c (P=0.89) with improvement of HS. Reduction in HbA1c was not associated with HS improvement (P=0.23). There was no difference in improvement rates between never smokers and former or current smokers (P=0.40).

Our findings suggest that GLP-1RA use may be associated with improved HS outcomes in overweight and obese patients, potentially through mechanisms related to weight reduction. Furthermore, improving overall metabolic state likely reduces baseline inflammation and increases the likelihood of response to standard HS treatments. While GLP-1RAs may be promising as an adjunct therapy for these HS patients, further investigation is needed to elucidate the degree to which weight reduction and metabolic/inflammatory modulation contribute to their therapeutic potential before their routine use can be recommended. Notably, the retrospective nature of our study and the lack of a comparator group limit our ability to determine causality. Furthermore, given that HS patients often receive multimodal treatment, future prospective studies should control for concomitant therapies to better isolate the effects of GLP-1RAs. Additional studies should also assess whether insurance status or healthcare utilization patterns, potential confounders of our study, contribute to differences in HS outcomes. Despite these limitations, our findings highlight a potential association between GLP1-RA use and HS improvement, warranting further investigation in randomized controlled trials.

TABLE 1.

Baseline Demographic and Clinical Characteristics	
Clinical Parameter	**Results n (%)**
Sex	
Male	12 (8.5%)
Female	130 (91.5%)
Race/Ethnicity	
Black	82 (57.7%)
White	46 (32.4%)
Asian	6 (4.2%)
Hispanic/Latino	5 (3.5%)
American Indian/Alaskan Native/Native Hawaiian	3 (2.1%)
Smoking status	
Current	21 (14.8%)
Former	28 (19.7%)
Never	93 (65.5%)
Metabolic parameters	
Initial body mass index (kg/m^2, mean ± SD)	41.1 ± 8.8
Initial hemoglobin A1C (mean ± SD)	6.7 ± 2.2
GLP1-RA received	
Semaglutide	125 (88.0%)
Liraglutide	46 (32.4%)
Tirzepatide	44 (31.0%)
Dulaglutide	9 (6.3%)
Exenatide	2 (1.4%)
Switched to a different GLP-1RA	59 (41.5%)
Comorbidities	
Obesity	119 (83.8%)
Pre-diabetes mellitus	23 (16.2%)
Diabetes mellitus	65 (45.8%)
Hypertension	70 (49.3%)
Hyperlipidemia	55 (38.7%)
Polycystic ovarian syndrome	23 (16.2%)
Hyperthyroidism or hypothyroidism	18 (12.7%)
Coronary artery disease	2 (1.4%)

GLP1-RA, glucagon-like peptide-1 receptor agonist

TABLE 2.

Hidradenitis Suppurativa Clinical Activity and Treatments Received	
Clinical Parameter	**Results n (%)**
Age at HS diagnosis (years, mean ± SD)	38.6 ± 12.0
Duration of HS symptoms prior to initial visit (years, mean ± SD)	11.4 ± 9.1
Hurley stage at initial visit	
I	27 (19.0%)
II	22 (15.5%)
III	14 (9.9%)
Not documented	79 (55.6%)
Hurley stage at most recent visit	
I	26 (18.3%)
II	30 (21.1%)
III	24 (16.9%)
Not documented	62 (43.7%)
HS treatments received at any point in HS course	
Topical antibiotics	124 (87.3%)
Oral antibiotics	93 (65.5%)
Antiseptic washes	94 (66.2%)
Biologics	33 (23.2%)
Spironolactone	51 (35.9%)
Metformin	4 (2.8%)
HS course post GLP1-RA initiation	
Improved	85 (59.9%)
No change	43 (30.3%)
Worsening	14 (9.9%)
Duration of HS follow-up (days)	
Mean	1804
Median	1219
Range	41-5825

HS, hidradenitis suppurativa
GLP1-RA, glucagon-like peptide-1 receptor agonist

DISCLOSURES

Dr Taylor has served as a consultant, advisory board member, and/or speaker for AbbVie, Arcutis, Armis Scientific, Avita, Beiersdorf, Biorez, Bristol-Myers Squibb, Cara Therapeutics, Dior, Eli Lilly, EPI Health, Evolus, Galderma, GloGetter, Hugel America, Incyte, Johnson & Johnson, L'Oreal USA, Medscape, MJH LifeSciences, Pfizer, Piction Health, Sanofi, Scientis US, UCB and Vichy Laboratories. She has received royalties from McGraw-Hill. She has served as an investigator for Allergan, Concert Pharmaceuticals/Sun Pharma, Croma-Pharma GmbH, Eli Lilly, and Pfizer. Dr. Ogunleye has served as a consultant, advisory board member, and/or speaker for Beiersdorf, MJH LifeSciences, Dermatology Times, Veradermics, and Health Central.. Author Encarnacion, Author Desir, Author Anusionwu, Author Hislop, and Author Feldman have no conflicts of interest to declare.

Ethical Approval: Reviewed and exempted by the University of Pennsylvania; IRB # 855643.

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BRIEF COMMUNICATION

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What Drives the Aesthetic Journey? A Survey of the Cosmetic Concerns for African-American Women

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INTRODUCTION

The number of aesthetic procedures performed among African-American (AA) patients in the United States increased 43% between 2012 and 2019.[1,2] Although there has been a recent focus on understanding the motivations for aesthetic procedures among AA patients,[3,4] data specifically addressing the concerns of AA women remain limited. To better characterize the factors that prompt AA women to seek dermatologic consultation and pursue aesthetic procedures, we conducted a survey through a dermatology practice with a substantial AA patient population.

MATERIALS AND METHODS

The IRB-approved, single-center survey included women of color, 20 to 80 years of age (Table 1), who were able to read and understand English and resided in Maryland and Washington, DC. Data were collected between September 13, 2021, and January 8, 2022, using a questionnaire administered via QuestionPro. Survey domains included demographics, beauty and skincare concerns, sunscreen usage, perceptions of skin aging, history of aesthetic procedures, and definitions of "natural" aesthetic results. Data analysis was performed using Microsoft Excel to assess frequency distributions, central tendencies, and variability.

RESULTS

A total of 144 AA women completed the survey, with 53.5% between the ages of 41 and 60 years old. Among respondents, 65.3% reported a history of dermatologic or cosmetic procedures, while 24.0% of those who had not previously undergone a procedure indicated willingness to pursue one. Primary motivations for seeking aesthetic procedures included reducing signs of aging (62.5%), maintaining appearance as part of their lifestyle (50.0%), and enhancing self-confidence (43.8%). External influences, such as suggestions from others (14.6%) or social media/influencers (2.8%), were reported less frequently.

Regarding the responders' current facial and cosmetic concerns, the most frequently selected was hair loss (54.2%), followed by dark spots (51.4%), unwanted facial hair (49.3%), dark circles under the eyes (45.1%), and blotchy or uneven skin tone/color (43.8%) (Figure 1).

TABLE 1.

Demographics of Survey Respondents. (N=200).

Ethnicity	No. (%)
Black/African-American	144 (100%)
Age Range	No. (%)
20-30	22 (15.3)
31-40	5 (3.5)
41-50	34 (23.6)
51-60	43 (29.9)
61-70	24 (16.7)
70-80	16 (11.1)
Marital Status	
Single (Never Married)	53 (36.8)
Married	53 (36.8)
Separated/Divorced/Widowed	38 (26.4)
Level of Education	
High school diploma or GED	4 (2.8)
Some college or 2-yr degree	21 (14.6)
Bachelor's degree	51 (35.4)
Graduate degree	68 (47.2)
Annual Household Income	
Less than $50,000	10 (6.9)
$50,000 - $100,000	45 (31.3)
$100,000 - $ $150,000	42 (29.2)
$150,000 or more	47 (32.6)
Current Residential Location	
Rural	1 (0.7)
Suburb	117 (81.3)
Urban	26 (18.1)

Notably, 59.0% of respondents reported current use of an anti-aging product in their skin care routine (Figure 2), and 50% of respondents believed that anti-aging products should be included in a regimen prior to the age of thirty. Most of the women (61.8%) were using or planning to use skincare products to maintain or boost a cosmetic procedure. Sunscreen use

FIGURE 1. Current facial and cosmetic concerns of respondents (N=144); x axis is percentage of respondents who selected item.

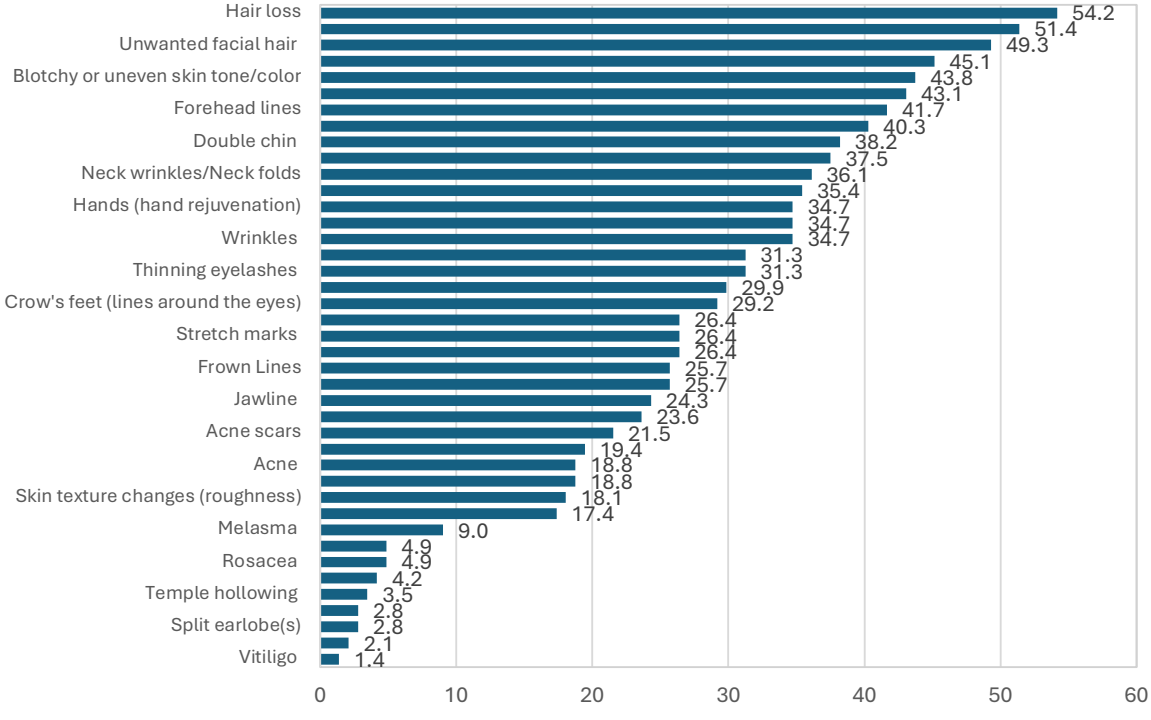
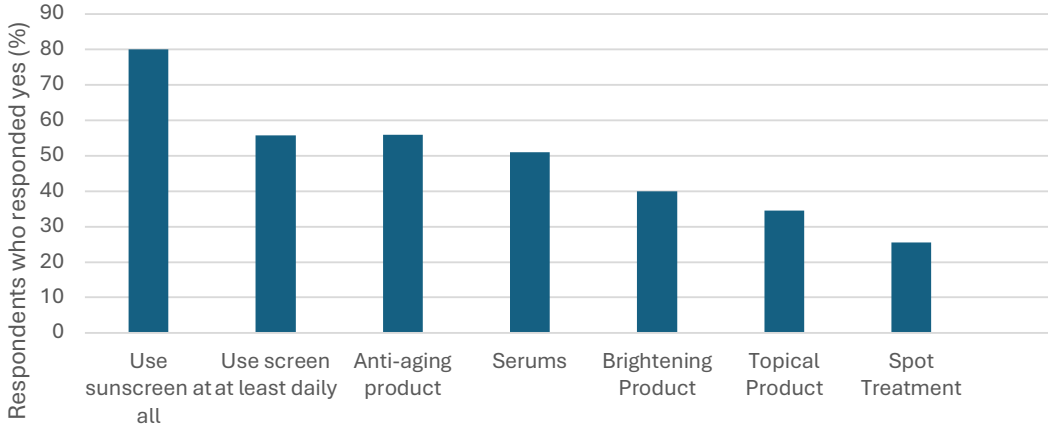


FIGURE 2. Skincare products included in the beauty routine of respondents (N=144).



was reported by 80% of participants, with 76% selecting SPF 30 or higher and 71% applying sunscreen multiple times per week. However, 34.7% expressed dissatisfaction with skincare products due to challenges in shade matching, citing issues such as a white cast from sunscreens.

DISCUSSION

While prior studies have identified acne and dermatitis as common reasons for dermatologic consultation among AA patients,[5] our findings suggest that hair loss and facial hyperpigmentation are primary concerns among AA women seeking dermatologic and cosmetic care. These concerns may represent an entry point into the AA woman's aesthetic journey.

Findings from our study highlight that AA women are interested in treatments for hair loss and report it as their number one cosmetic concern. While there have been advancements in treatment options for hair loss, there is a lack of consensus data on the cosmetic procedures available for hair loss when medical management has not been successful. Hair restoration techniques also differ for this population given the clinical characteristics of curly or coily hair.[6,7] Our study elucidates the

utility of increased research and development of available and future cosmetic hair procedures.

Additionally, the principal motivations for these women to undergo an aesthetic procedure were based on their own desires to maintain a more youthful appearance and increase their self-confidence, with societal pressures having limited influence. This finding aligns with previous studies, which have found that patients undergoing cosmetic procedures are motivated by internal factors such as wanting to be more attractive and look younger for themselves rather than for other people.[8] Definitions of "natural" results emphasized maintaining authenticity and aging gracefully, with common responses being a need to "not look fake," and "look like myself," and "look the best I can look at my age."

Additionally, findings of this study underscore that, for AA women, proper skincare is an important factor in their aesthetic routine, with an understanding that skincare products are an essential pairing to complement an aesthetic or cosmetic procedure.

Furthermore, results from our study also illustrate that AA women want to use skincare products like sunscreen, but finding a matching tone has been a barrier to creating an ideal skincare regimen.[9] Recent published data emphasize the superiority of tinted mineral sunscreen for patients with skin of color, as iron oxides can decrease post-inflammatory hyperpigmentation by blocking visible light. Tint in mineral sunscreens also provides some protection against visible light, but also makes mineral sunscreens more cosmetically elegant by decreasing the appearance of a "white cast" on the face, which our study found is a barrier to some AA women being able to wear sunscreen.[10] This further supports the importance of continuing to offer a wide range of tones for sunscreen products.

While some results from this study support previous conclusions about motivations for and goals of obtaining a cosmetic procedure, the results of this study highlight the differences in cosmetic concerns in AA women compared with other ethnic groups.[3] These differences present an untapped market for innovation in cosmetic procedures that can be offered to AA female patients.

Limitations to the study include the small number of participants, the majority being from a single site and already under the care of a dermatologist, and fewer women represented in the younger age groups.

DISCLOSURES

Janet Wangari Olivero, Ying Chen, and Qian Zheng are employees of L'Oreal Research & Innovation, USA. Dr. Callender disclosures: Advisory Board: Beiersdorf, Juenes Aesthetics, L'Oreal, Ortho Derm, SkinCeuticals; Consultant: Estee Lauder, LaRoche Posay; Investigator: AbbVie, Avava, Eli Lilly, Eirion Therapeutics, Incyte, Janssen, Pfizer, Prollenium, Regeneron, Symatese, Teoxane; Speaker: Aerolase, Arcutis, Cutera, L'Oreal, Pfizer; Author and Royalties: UpToDate; Honorarium: Aerolase, Arcutis, Beiersdorf, Cutera, Juenes Aesthetics, LaRoche Posay, L'Oreal, Ortho Derm, Pfizer, SkinCeuticals, Estee lauder; Research Funding: AbbVie, Avava, Eli Lilly, Eirion Therapeutics, Janssen, Pfizer, Prollenium, Symatese, Teoxane, Regeneron. The remaining authors have no conflicts of interest to disclose.

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BRIEF COMMUNICATION

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A Systematic Evaluation of Mpox Public Health Educational Resources

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INTRODUCTION

Mpox (formerly known as monkeypox), a zoonotic orthopoxvirus related to smallpox, was first identified in humans in the Democratic Republic of the Congo in 1970 and was historically endemic to Central and West Africa, with mainly animal-to-human transmission.[1-4] However, the 2022 global outbreak marked an epidemiological shift, spreading to non-endemic regions like the United States and disproportionately affecting specific demographics, including men who have sex with men (MSM).[1,5] By the end of 2022, the US reported over 30,000 cases, with New York City having the largest outbreak.[1] Significant delays in diagnosis and reporting were noted, particularly a median 4-day delay in NYC, which can increase transmission risk in vulnerable populations.[2]These outbreaks highlight the critical role of timely, accessible public health communication tailored by local health departments, though studies reveal that such communication often remains insufficient.[6]

A significant portion of the general population struggles with health literacy making the clarity and readability of public health materials essential for effective communication, with one study finding that up to 36% of adults in the United States are health illiterate.[7,8] Prior studies have validated readability metrics, such as the Flesch-Kincaid score, to assess the accessibility of these materials.[1] Lessons from the COVID-19 pandemic emphasize the importance of clear, empathetic messaging in building public trust to ensure compliance.[2] One study explicated the function of health literacy as a social vaccine, serving a crucial role in mitigating the spread of disease by "understanding and applying information as provided through governments and health authorities".[3] This work, and the increasingly frequent rise of epidemic and pandemic infections, highlights the need for timely and accurate information dissemination to combat misinformation and guide public behavior.

Despite growing awareness of these challenges, there remains a lack of research evaluating the accessibility of public health communications during health crises. Governmental resources must be tailored to reach a broad audience, especially those with limited health literacy. Resources that exceed the 8th-grade level may leave many without the information needed to appropriately protect against or seek care for emerging communicable diseases.[9] This study aimed to evaluate the readability of Mpox-related educational materials intended for the public, from various public health agencies, and to identify potential barriers that may hinder public understanding and response.

MATERIALS AND METHODS

Given the significant public health impact of human immunodeficiency virus (HIV) and the recent resurgence of Mpox, as outlined by recent studies on public health communication strategies and disease efforts,[10] evaluating health information dissemination on these infections is critical. Health information targeted to the general population on Mpox and HIV was collected from publicly accessible websites of three types of health departments in each of the 50 US states: state-level departments, the largest metropolitan departments, and one randomly selected non-metropolitan department per state. This sampling approach was designed to capture a diverse cross-section of public health messaging across urban and rural settings.

For each website, standardized search terms, including "Mpox/HIV prevention," "Mpox/HIV treatment," "Mpox/HIV diagnosis," and "Mpox/HIV reporting," were used to identify relevant educational and informational materials. Data were extracted and categorized by type: prevention, treatment, and diagnosis, and further evaluated for content and accessibility.

To assess inclusivity and cultural relevance, the presence of diverse visual representation was evaluated using the Fitzpatrick Skin Type categorization, which classifies human skin color into six types based on pigmentation and risk of sun damage, and the Monk Scale, an alternate validated scale of skin tone and pigment. This method enabled the objective quantification of the diversity of individuals depicted in health materials, aiming

to ensure representation of various racial and ethnic groups.[11] Additional accessibility metrics also included identification of simple language usage, availability of translation options, and readability assessment. The readability of the collected materials was assessed using the Flesch-Kincaid readability score, a widely used and validated metric that evaluates text complexity based on sentence length and word difficulty, providing an approximation of the US school grade level required for comprehension.[12] Chi-square tests were performed to identify significant differences in the availability and readability of prevention, diagnostic, and treatment information across department types (state, metro, non-metro), and visualization techniques, such as heatmaps and bar charts, were generated to illustrate these differences and to identify gaps in resource availability and accessibility.

Furthermore, the association of findings with political leanings was evaluated to investigate the role of policy preferences in public health education efforts. Political leanings were identified via party affiliation as defined by the following considerations: Democrat-leaning or Republican-leaning states were states that had majority electoral votes of the respective party in at least three of the last four presidential elections (2012, 2016, 2020, 2024). Swing states were defined as states that, in the last four presidential elections, the electoral votes were evenly split between the Republican and Democratic Parties. The number of available resources, as determined by the aforementioned measures, and language availability were compared between Democrat-leaning states, Republican-leaning states, and swing states.

RESULTS

State Health Department

The majority (96%) of state departments had information on their websites on Mpox, while 88% (44/50) provided HIV information. Of the states with Mpox data available on their websites, 34% mentioned at-risk populations, and 10% explicitly mentioned racial demographics. Visual resources were available in only 23/50 (46%) of state departments, with 47% of images depicting lighter skin tones (FST I-III) and 53% depicting darker skin tones (FST IV-VI). The FST results suggest statistically significant underrepresentation of lighter skin tones (FST I-III) and overrepresentation of darker skin tones (FST IV-VI) in the Mpox images ($P<0.01$). The average Flesch-Kincaid reading score for state department materials was 10.5, indicating a high school reading level, above the recommended 8th grade level (Flesch-Kincaid of 8) for public health materials. The average ease score was 40.1, which is below the recommended score of 60-70, indicating that the materials were difficult for the average reader to understand.

Figure 1 and Figure 2 highlight the availability of key Mpox and HIV resources across state health departments based on the measures outlined prior. Both figures indicate that coastal areas provided more comprehensive Mpox information, including guidance on prevention, diagnosis, treatment, and targeted messaging for high-risk populations.

FIGURE 1. Heatmap of resource availability across state health departments.

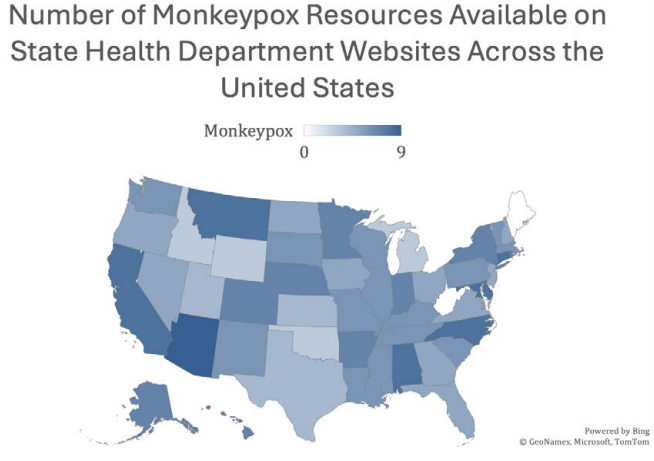
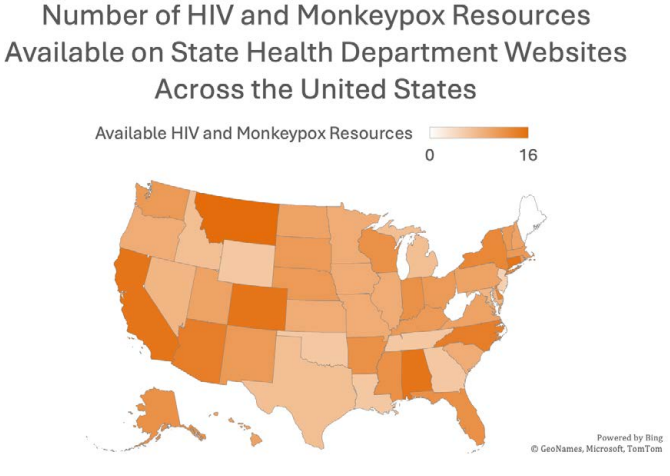


FIGURE 2. Bar chart of resource availability counts for both HIV and Mpox state health departments.



Among 20 identified Democratic States, 27 Republican States, and 3 Swing states, there were no statistically significant differences in the number of Mpox resources ($P>0.05$). Additionally, there was no significant influence of political leaning on the availability of non-English language offerings for educational resources ($P=0.3$) and on mention of at-risk populations in available Mpox resources ($P=0.2$).

TABLE 1.

Distribution of Fitzpatrick Skin Types (FST) and Monk Skin Tones (MST) Represented in Mpox Resources Across Health Departments

Department Type	FST I–III	FST IV–VI	MST 1–5	MST 6–10
Local Non-Metro	16	22	16	22
Local Metro	33	34	32	35
State	57	64	43	51
Totals	106	120	91	108
P (Non-Metro vs Metro)	.62*		.72**	
P (State vs Local)	1.00*		1.00**	
P *P* (Among States)	*P*<.001 †		*P*<.001 †	

Chi-square analyses showed no significant differences (all *P*>0.05) comparing FST and MST distributions across all department types when adjusted for FST population distribution[14]
*There were no significant differences in the distribution of images across Fitzpatrick Skin Types when comparing local non-metro and local metro health departments or when comparing local and state health departments.
**There were no significant differences in the distribution of images across Monk Skin Tones when comparing local non-metro and local metro health departments or when comparing local and state health departments.
†FST and MST results suggest statistically significant underrepresentation of lighter skin tones (FST I-III) compared to darker skin tones (FST IV-VI) in the Mpox images depicted among state health department websites.

Local Metro vs State Health Departments

However, for major metro areas, information was further limited. 66% of local metro departments had Mpox information. State departments had 1.55 times more resources regarding prevention, treatment, and diagnosis data compared to the local metro departments (*P*<0.01). However, Metro departments also provided more diverse language options, including Spanish, French, and Mandarin.

DISCUSSION

The 2022 Mpox outbreak marked a significant shift in the epidemiology of a virus historically confined to Central and West Africa, with urban centers across the United States becoming hotspots for rapid transmission. Meanwhile, HIV continues to be a major public health concern, particularly among marginalized communities disproportionately affected by both viruses. Clear, accessible, and culturally competent public health messaging remains essential for controlling the spread and improving outcomes for these populations.[1]

We assessed the readability of Mpox and HIV health information provided by the US state public health department websites using the Flesch-Kincaid Reading Ease Score. This commonly used tool evaluates text complexity based on sentence strength and syllable count. While statistical comparison between Mpox and HIV resources showed no significant difference in average readability, the mean scores remained in a range suggesting moderate difficulty, often exceeding the recommended 6th-8th grade level for public health communication. This finding aligns with broader concerns about health literacy and accessibility in public materials. Given that complex language can disproportionately affect marginalized populations, these results underscore the need for plain-language revisions to improve public engagement, particularly during outbreaks that require widespread, rapid dissemination of information.

These findings reveal substantial disparities in the availability and quality of Mpox-related public health information across US health departments, regardless of political leaning, suggesting a global need for improved attention to improving public health efforts. We observed inconsistencies in how at-risk groups, such as the LGBTQ+ individuals and racial and ethnic minorities, were addressed in both the visual and written content in public health materials. Although diverse imagery was often present, it was not always accompanied by tailored or contextually relevant messaging. This trend echoes broader issues in public health and clinical education, where communities of color are frequently depicted in the context of infectious diseases, specifically sexually transmitted infections, rather than across a full spectrum of health concerns. Such patterns can reinforce stigma and perpetuate harmful narratives around disease risk.[13] Standardizing educational materials to accessible language and culturally relevant content is critical for improving health outcomes in future public health crises.

Our analysis found significant disparities in the availability of prevention, diagnostic, and treatment information across local metro health departments. Our study was limited by a potential correlation between outbreak severity and the comprehensiveness of information provided by each state. For example, states like New York, which were more heavily impacted by Mpox, may have generated more extensive data compared to states with fewer cases. However, our findings suggest that the paucity of granular data in metro areas can be of concern, as large cities were targets for the spread and required their own guidelines, as in New York City.

DISCLOSURES

The authors have no potential conflicts of interest or competing interests to disclose.

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BRIEF COMMUNICATION

Journal of Drugs in Dermatology

Treatment of Generalized Granuloma Annulare With Biologics and Oral JAK Inhibitors: A Case Series

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INTRODUCTION

Granuloma annulare (GA) is a granulomatous inflammatory skin condition of unknown etiology, often presenting as annular plaques or papules.[1] Generalized GA (GGA) is a rare subtype of GA characterized by its widespread distribution and resistance to conventional treatments such as topical or intralesional corticosteroids.[2] The rarity of the disease and lack of evidence-based treatment guidelines pose a unique management challenge. Biologics and oral JAK inhibitors have increasingly been used for refractory GGA cases.[3] We sought to characterize the outcomes of these therapies used for GGA in a large academic center.

GA is characterized by an upregulation of Th1, Th2, Th17, Th22, and JAK-STAT pathways. There is an increased expression of cytokines such as TNF-α, IL-1β, IFN-γ, IL-12/23p40, IL-4, and IL-31.[2] Due to the upregulation of these inflammatory pathways in GA, therapies that target these pathways have been used off-label to treat GGA.[4] Several reports have shown improvement or remission with systemic therapies, including JAK inhibitors, TNF-α inhibitors, IL-4 blockers, and IL-23 blockers.[4]

We conducted a retrospective case series of adult GGA patients treated with a biologic or oral JAK inhibitor at a single academic dermatology clinic (November 2016 to January 2025). Patient demographics, medical history, disease extent, and treatment response, assessed by changes in erythema, induration, and lesion count were obtained via medical records (Table 1).

CASE SERIES

We identified 22 patients (mean age 59.4 years; range 32–77), 90% (n=20) females, and 77% white (Table 2). All patients had recalcitrant disease, having previously attempted corticosteroids (topical, intralesional, or oral), topical ruxolitinib (n=4), hydroxychloroquine (n=6), oral antibiotics (n=6), and phototherapy (n=3).

Adalimumab was the most prescribed therapy (n=11), 63.6% experienced marked response or remission. Dupilumab (n=8) led to moderate or better responses in 62.5% of patients, and one achieved remission. All patients on upadacitinib (n=5) had a positive response, with 80% noting a marked response or remission. Among the 2 patients on abrocitinib, one achieved

TABLE 1.

Summary of Response of Patients With Generalized GA by biologic/oral JAK Inhibitor

Drug	Patients Treated	Drug Class	Clinical Response	Average Response Time	Adverse Events
Adalimumab	11	TNF-α inhibitor	Clinical remission (n=5) Marked response (n=2) Moderate response (n=1) Minimal response (n=2) No response (n=1)	6–7 months	Psoriasiform eruption (n=1)
Dupilumab	8	IL-4 and IL-13 blocker	Clinical remission (n=1) Marked response (n=0) Moderate response (n=4) Minimal response (n=1) No response (n=2)	4–5 months	None
Upadacitinib	5	JAK 1 inhibitor	Clinical remission (n=1) Marked response (n=3) Moderate response (n=1) Minimal response (n=0) No response (n=0)	7–8 months	Bloating, constipation, weight gain, acne (n=1)
Abrocitinib	2	JAK 1 inhibitor	Clinical remission (n=1) Marked response (n=0) Moderate response (n=0) Minimal response (n=1) No response (n=0)	3–4 months	Hives/ eczema outbreak (n=1)
Certolizumab	1	TNF-α inhibitor	Clinical remission (n=1)	4 months	None

Clinical Response:
1. 0% (no response)
2. <25% (minimal response)
3. >25%, <75% (moderate response)
4. >75%, <100% (marked response)
5. 100% (clinical remission)

*Because this was a retrospective study, data for patients were recorded when patients returned for visits. In many cases, the condition improved before follow-up visits.

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TABLE 2.

Patients With Generalized GA Treated With Biologics or Oral JAK Inhibitors and Their Clinical Response

Patient No. /Age/ Sex/Race	Comorbidities	Previous Therapies	Biologic/ Oral JAK Inhibitor	Therapy Duration	Skin Involvement	Clinical Response	Time Until Response	Adverse Events
1/ 64/ M/ White	Asthma	Topical steroids Ciprofloxacin Rifampin Pulsed minocycline	Adalimumab	6.5 months (discontinued)	Extremities, bilateral axillae, abdomen, back, groin	Minimal response	6.5 months	None
			Upadacitinib	16 months (ongoing)		Clinical remission	11 months	
2/ 58/ F/ White	Hashimoto's thyroiditis, hyperlipidemia	Topical steroids	Adalimumab Upadacitinib Abrocitinib	13 months (discontinued) 2 months (discontinued) 7 months (ongoing)	Legs, trunk	Minimal response Moderate response Clinical remission	5 months	Bloating, constipation, weight gain, acne on upadacitinib
3/ 65/ F/ Other	Hyperlipidemia, T2DM	Hydroxy-chloroquine Pentoxifylline Dapsone Phototherapy Oral minocycline Topical steroids IMTAC Acitretin Doxycycline	Adalimumab	5.5 months (discontinued)	Extensor forearms, left posterior thigh, trunk	Marked response, but discontinued due to drug eruption rash.	3 months	Psoriasiform eruption (TNF-α related drug reaction)
4/ 68/ F/ White	Hyperlipidemia	Topical steroids ILTAC	Upadacitinib	7 months (ongoing)	Right index finger, bilateral extensor elbows	Marked response	4 months	None
5/ 43/ F/ White	None	Oral steroids Doxycycline ILTAC Phototherapy	Adalimumab	4 yrs (ongoing)	Lower extremities, elbows	Clinical remission	6 months	None
6/ 68/ M/ Unknown	Atopic dermatitis	Topical steroids	Dupilumab	8 months (ongoing)	B/l Shoulders, arm, L arm, L thigh	Moderate response	7 months	None
7/ 58/ F/ White	Hashimoto's thyroiditis, Celiac disease, Atopic dermatitis	Hydroxy-chloroquine Topical steroids ILTAC	Abrocitinib	3 months (discontinued)	B/l upper extremities, medial thighs, lower legs, dorsum of feet bilaterally.	Minimal response, discontinuation due to hives/ eczema outbreak	2 months	Hives/ eczema outbreak
8/ 49/ F/ White	Atopic dermatitis	Topical steroids Topical ruxolitinib Oral steroids Dapsone	Dupilumab	26 months (ongoing)	Upper and lower extremities	No response	N/A	None
9/ 68/ F/ White	Psoriasis	Topical steroids ILTAC	Adalimumab	3.5 yrs (ongoing)	B/l ankles and lower legs	Clinical remission	7 months	None
10/ 32/ F/ White	Alopecia areata	Topical steroids Hydroxy-Chloroquine ILTAC Topical tofacitinib	Dupilumab	7 months (discontinued)	Trunk, back, and neck	Minimal response	4 months	None
11/ 67/ F/ Black	Dyshidrotic eczema, atopic dermatitis	Topical steroids Topical ruxolitinib	Adalimumab	11 months (ongoing)	Arms, thighs	Clinical remission, then flare	2 months	None
			Dupilumab	7 months (ongoing)		Clinical remission	3 months	
12/ 48/ F/ White	Hypothyroidism, seborrheic dermatitis	Topical steroids	Upadacitinib	11 months (ongoing)	Dorsal hands, chest, back	Marked response	9 months	None

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TABLE 2. (CONTINUED)

Patients With Generalized GA Treated With Biologics or Oral JAK Inhibitors and Their Clinical Response

Patient No. /Age/ Sex/Race	Comorbidities	Previous Therapies	Biologic/ Oral JAK Inhibitor	Therapy Duration	Skin Involvement	Clinical Response	Time Until Response	Adverse Events
13/ 54/ F/ White	Psoriasis	Topical steroids	Dupilumab Adalimumab	5 months (discontinued) 15 months (discontinued)	Abdomen, bilateral inner thighs	No response	N/A	None
14/ 75/ F/ White	Ulcerative colitis	Topical steroids Hypochlorous acid NBUVB	Certolizumab pegol	6 yrs (ongoing)	Generalized	Clinical remission	4 months	None
15/ 63/ F/ White	Psoriasis	Topical steroids Doxycycline, Hydroxy-chloroquine	Adalimumab	11 months (discontinued)	B/l lower legs and forearms	Moderate response	12 months	None
16/ 54/ F/ White	Lichen sclerosis	Topical steroids Methotrexate Acitretin	Adalimumab	7 months (discontinued)	B/l lower extremities	Clinical remission	5 months	None
17/ 74/ F/ White	Sarcoid uveitis, psoriasis	Topical steroids Oral steroids Methotrexate UBUVB	Adalimumab	7 months (ongoing)	Chest, abdomen, B/l upper and lower extremities	Marked response	5 months	None
18/ 44/ F/ White	None	Topical steroids ILTAC Topical ruxolitinib	Adalimumab	27 months (ongoing)	Neck, chest, b/l arms	Clinical remission	6 months	None
19/ 66/ F/ Unknown	Atopic dermatitis	Topical steroids ILTAC	Dupilumab	26 months (ongoing)	Arms, chest	Moderate response	6 months	None
20/ 63/ F/ White	Atopic dermatitis	Ustekinumab Oral steroids Topical steroids	Dupilumab	16 months (ongoing)	Legs, arms, abdomen, face, buttocks	Moderate response	6 months	None
21/ 48/ F/ White	Atopic dermatitis, osteoporosis	Topical steroids Topical ruxolitinib Hydroxy-chloroquine Doxycycline	Dupilumab	6 months (ongoing)	Generalized	Moderate response	2 months	None
22/ 77/ F/ White	Hypothyroidism, hyperlipidemia	Topical steroids Minocycline, Ofloxacin Rifampin Hydroxy-chloro-quine Phototherapy	Upadacitinib	5 months (ongoing)	Bilateral anterior and posterior legs	Marked re-sponse	6 months	None

JAK, Janus kinase; NB, narrowband; UV, ultraviolet; b/l, bilateral.

remission. One patient treated with certolizumab-pegol for 6 years achieved remission (Table 1).Two patients unresponsive to adalimumab achieved remission after switching to an oral JAK inhibitor. One patient on adalimumab relapsed and achieved remission upon addition of dupilumab combination therapy.

Three patients reported adverse events (Table 2). One patient reported a psoriasiform eruption on adalimumab, a reported side effect of TNF-α inhibitors, and therapy was discontinued. Another reported moderate GI discomfort, weight gain, and acne on upadacitinib, which are all reported side effects of oral JAK inhibitors, and therapy was discontinued. The last reported hives/eczema outbreak after 3 months on abrocitinib and therapy was discontinued. No serious adverse events were reported.

DISCUSSION

While the pathogenesis of GA is not fully understood, targeting the known inflammatory pathways in GA can lead to improvement or clinical remission in patients with recalcitrant GGA.

To our knowledge, this is the largest case series of patients with GGA treated with biologics or oral JAK inhibitors. Out of

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22 patients, nearly all experienced at least some improvement in erythema, induration, and the formation of GA lesions, with 13 (59.1%) patients experiencing a marked response or clinical remission. Most patients who experienced marked response or clinical remission were treated with adalimumab (63.6%, 7/11) or upadacitinib (80%, 4/5).

Adalimumab is a TNF-α inhibitor that has shown efficacy in the treatment of several granulomatous diseases, such as Crohn's disease and sarcoidosis.5 Upadacitinib is a selective JAK-1 inhibitor currently FDA-approved for the treatment of multiple autoimmune and inflammatory skin diseases.[6] Emerging reports suggest that biologics such as adalimumab and oral JAK inhibitors such as upadacitinib may also be effective treatment options for GGA.[7,8] However, most of these reports are confined to case reports and small case series'. We observed positive outcomes in 20 patients, and marked response or clinical remission in 13 patients. In addition, few reports have described treatment with biologics or JAK inhibitors after recurrence or failure on another biologic or JAK inhibitor. We observed clinical remission in two patients on oral JAK inhibitors (one on upadacitinib and one on abrocitinib) who had experienced minimal response to adalimumab.

The selection of a therapy of choice for GGA patients should involve a discussion between the dermatologist and the patient, taking into account safety, monitoring, patient expectations, patient comorbidities, and quality of life. This study is limited by its small sample size and retrospective nature; however, we have shown positive results in the treatment of GGA with biologic and oral JAK inhibitors. Clinicians should proceed with caution when considering any systemic therapy off-label, but we did not experience any safety concerns in our small sample size. Evidence-based treatment guidelines derived from randomized controlled trials are warranted, as the majority of published research is still confined to case reports, case series, and singular retrospective studies.

DISCLOSURES

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IRB Approval Status: Institutional Review Board of the Mount Sinai School of Medicine, in accordance with Mount Sinai's Federal Wide Assurances (FWA#00005656, FWA#00005651), to the Department of Health and Human Services, approved the following human subject research.

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BRIEF COMMUNICATION

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Reddit Discourse on Eczema: Quantitative Analysis of Misinformation, Engagement, and Alignment With 2025 American Academy of Dermatology Guidelines

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INTRODUCTION

Atopic dermatitis (AD) is a chronic inflammatory disease with significant psychosocial burden.[1] Patients increasingly seek dermatological information and guidance on Reddit, a platform with over 70 million daily active users, which hosts disease-specific communities such as r/eczema.[2,3] These forums provide validation and peer support but may amplify misinformation.[4] The 2025 American Academy of Dermatology (AAD) atopic dermatitis guidelines offer a timely, evidence-based benchmark against which to evaluate this discourse.

MATERIALS AND METHODS

The authors conducted a cross-sectional analysis of the top posts from the r/eczema subreddit between May 25, 2024, and May 25, 2025. Of 210 posts screened, 123 met the inclusion criteria (English language, relevant to AD diagnosis; excluding off-topic and spam posts). Posts were thematically coded and scored using two frameworks: (1) a Guideline Alignment and Bias Scoring (GABS; a score from 0–5, a higher score indicated greater misinformation/bias. Criteria assessed included; testability, credibility, AAD contradiction, pseudoscientific claim, and basis of claim), and (2) AAD alignment (A score from 1–5, a higher score representing stronger guideline concordance).[5] Two independent raters scored posts; inter-rater reliability was high ($\kappa = 0.81$). Readability was assessed with the Flesch–Kincaid index. Pearson correlations evaluated associations among GABS, AAD alignment, engagement, and readability.

RESULTS

The most frequent themes were treatment success (n = 29), flare triggers (n = 25), and alternative remedies (n = 16). Alternative remedies (mean AAD = 2.69; mean GABS = 1.94) and misinformation/doubt (mean AAD = 2.20; mean GABS = 3.20) were the least AAD guideline-concordant. Empowerment and peer education (mean AAD = 4.70; mean GABS = 0.60) and flare triggers (mean AAD = 4.60; mean GABS = 0.80) demonstrated the highest concordance (Table 1). Overall, a higher GABS score strongly correlated with lower AAD alignment ($r = -0.77$, $P<0.001$), a pattern more pronounced at the theme-specific level ($r = -0.92$, $P<0.001$). Engagement metrics further reinforced this pattern: upvote percentage correlated positively with AAD alignment ($r = 0.34$, $P<0.001$) and negatively with GABS ($r = -0.37$, $P<0.001$), while comment count correlated with Reddit score ($r = 0.50$, $P<0.001$) (Figure 1). Readability was not significantly associated with information quality within both GABS and AAD alignment.

DISCUSSION

These results demonstrate that while Reddit discourse contains substantial misinformation, community engagement tends to favor posts aligned with dermatology guidelines. Dermatologists should be aware of these online dynamics, as they reveal barriers and narratives not easily captured in clinic settings. Proactive engagement through patient education, counseling that acknowledges alternative treatment narratives, and partnerships with digital health communities may help mitigate misinformation and support adherence to evidence-based management.

Study limitations include restriction to a single subreddit, lack of demographic information, and a cross-sectional design. Nevertheless, these findings demonstrate that social media captures patient perspectives not easily measured in clinic-based studies. Platforms may offer dermatologists valuable insights into barriers to care, adherence challenges, and lived experiences of disease.

Reddit discourse exhibits a complex interplay with medical guidelines. Higher GABS scores strongly correlated with lower AAD alignment, particularly in themes such as alternative remedies and misinformation. One post described frustration with the medical system, accusing dermatologists of profiting from the disease rather than seeking a cure. This sentiment

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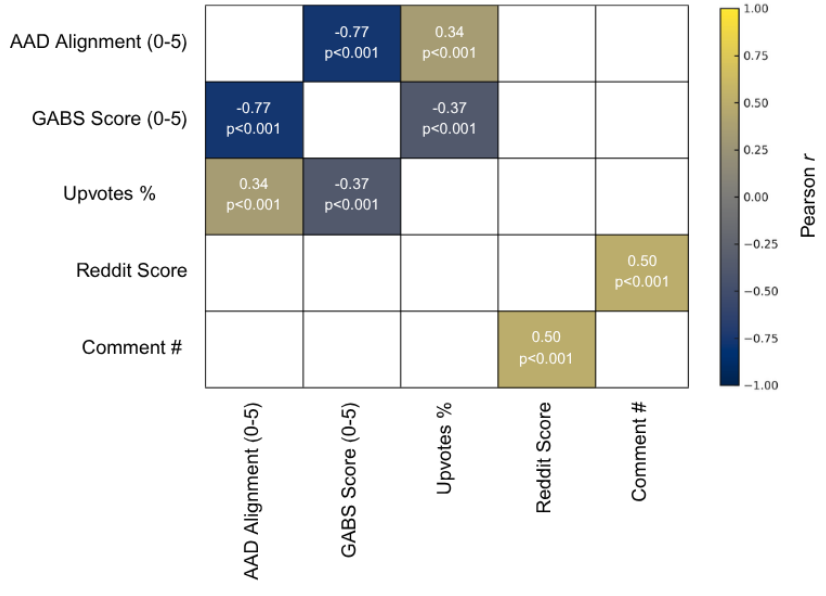
TABLE 1.

Theme-Specific Mean American Academy of Dermatology (AAD) Alignment and Global Acne Burden Score (GABS) Scores, With Correlation Summary

Section	Category	Total Posts	Mean AAD Alignment	Mean GABS Score
Theme-specific analysis	Access/Insurance Issues	1	5.0	1.0
Theme-specific analysis	Alternative Remedies	16	2.69	1.94
Theme-specific analysis	Childhood/Parenting	4	4.0	1.0
Theme-specific analysis	Crowdsourced Knowledge & Resource Sharing	1	5.0	0.0
Theme-specific analysis	Emotional Support and Affirmations	3	5.0	0.67
Theme-specific analysis	Empowerment & Comprehensive Peer Education	10	4.7	0.6
Theme-specific analysis	Flare Triggers	25	4.6	0.8
Theme-specific analysis	Lifestyle Impact	6	3.67	1.5
Theme-specific analysis	Mental Health Impact	8	3.88	1.38
Theme-specific analysis	Misinformation/Doubt	10	2.2	3.2
Theme-specific analysis	Seeking Advice	6	4.33	1.17
Theme-specific analysis	Treatment Failure	4	3.75	1.5
Theme-specific analysis	Treatment Success	29	4.55	0.66
Section	**Variables**		**Pearson Coefficient**	***P*-Value**
Correlation summary	GABS vs AAD alignment		-0.77	*P*<0.001
Correlation summary	Theme mean GABS vs mean AAD		-0.92	*P*<0.001
Correlation summary	Upvote % vs AAD alignment		0.34	*P*<0.001
Correlation summary	Upvote % vs GABS		-0.37	*P*<0.001
Correlation summary	Comments vs Reddit score		0.5	*P*<0.001
Correlation summary	Readability vs AAD		0.05	*P*=0.600
Correlation summary	Readability vs GABS		0.08	*P*=0.420

FIGURE 1. Heatmap illustrating the strength and direction of Pearson correlations among AAD alignment, GABS score, and engagement variables (upvotes, comments, and Reddit score).



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typifies the "Misinformation and Doubt" theme. While users tended to favor higher-quality information, guideline-discordant posts remained prominent. This duality suggests both risks and opportunities: patients experiencing the greatest burden may be most vulnerable to adopting non-guideline strategies. These findings, along with the discovery that readability is not a significant predictor of post quality, underscore the critical need for targeted interventions and evidence-based education in active online patient communities.

DISCLOSURES

The authors have no conflict of interest to declare.

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LETTERS TO THE EDITOR

Journal of Drugs in Dermatology

Reducing Administrative Burden in Dermatology Through Compounding Alternatives

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Letter to the Editor:

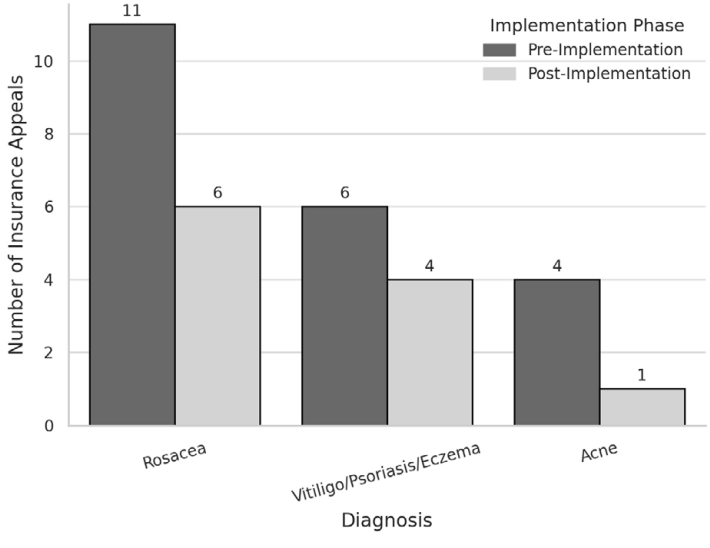
Administrative burdens, particularly prior authorization (PA) requirements and appeals, remain a significant barrier to timely dermatologic care. On average, physicians complete 39 PAs per week, dedicating 13 hours of staff and clinician time.[1] Nationally, 93% of physicians report that PAs delay access to necessary treatment, with one study reporting a median delay of 12 days to initiate care.[1,2] As a result, patients frequently arrive to clinic without having started any treatment due to the inability to obtain prescribed medications. In a 2024 national survey, 82% of physicians noted that PA can lead to treatment abandonment and 89% indicated that PAs contribute to burnout.[1] These data underscore the urgency of addressing administrative inefficiencies in dermatology. In response, we implemented a quality improvement initiative to increase provider awareness and use of compounded medications as alternatives when standard therapies were denied.

Dermatology residents and attending physicians at an academic medical center participated in targeted educational sessions covering the risks and benefits of compounded medications, appropriate clinical indications, ordering procedures, and patient counseling. Physicians were encouraged to offer compounded alternatives when a PA for a prescribed medication was denied in lieu of proceeding to an appeal.

To evaluate the intervention's impact, we compared the frequency of appeals three months before and after training using a chi-square test. The distribution of public vs private insurance did not differ significantly between groups. Following implementation, the proportion of appeals decreased from 6.7% to 2.5% (P=0.0081), suggesting that increased provider familiarity with compounding options may reduce administrative workload without compromising care (Figure 1). Informal feedback also indicated greater provider confidence in navigating compounded alternatives.

This initiative represents a scalable strategy to improve access to dermatologic treatment and reduce administrative burden. Incorporating compounding education into dermatology training may enhance efficiency and promote patient-centered care, particularly when insurance barriers preclude timely

FIGURE 1. Number of insurance appeals by dermatologic indication before and after intervention. The number of appeals is stratified by condition (rosacea, vitiligo/psoriasis/eczema, and acne) and by timepoint (pre-intervention in dark grey, post-intervention in light grey).



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access to standard therapies.[3] Additionally, reducing the need for appeals when PAs are denied may mitigate physician frustration and burnout, growing concerns in dermatology practice.[4]

While these results suggest a potential reduction in administrative workload, several limitations must be acknowledged. First, compounding pharmacies are not regulated to the same degree as commercial pharmaceutical manufacturers, raising safety concerns regarding consistency, sterility, and dosing accuracy.[5] Second, compounded medications are often not covered by insurance and require patients to pay out of pocket. While the formulations used in our clinic typically cost $35-45, comparable to standard co-pays, they do not contribute toward deductibles. This initiative was conducted at a single academic institution, which may affect generalizability. We used the frequency of PA appeals as a proxy for administrative burden and did not assess patient outcomes or satisfaction with compounded therapies. We also were unable to compare time to medication receipt between standard and compounded prescriptions.

This initiative demonstrates that structured provider education on compounded medications can reduce the frequency of PA appeals, offering a pragmatic solution to an increasingly burdensome aspect of dermatologic care. Future efforts should evaluate patient outcomes, satisfaction, and time to treatment when compounded alternatives are used. Multi-institutional studies are also warranted to assess generalizability and long-term impact. Integrating compounding education into residency curricula may represent a sustainable strategy to enhance care delivery and reduce physician burnout across practice settings.

DISCLOSURES

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LETTERS TO THE EDITOR

Journal of Drugs in Dermatology

Enhancing Patient Privacy in Dermatology: Best Practices for Image Organization and Security

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To the Editor:

The increasing use of digital images in dermatology for diagnostic and treatment purposes presents serious privacy and security concerns. Dermatologists routinely collect and retain photos of skin disorders, both cutaneous and histopathological, to make accurate diagnoses and plan treatments. However, the possibility of these photos being compromised by cyberattacks necessitates strict security measures.[1]

Common image formats used in dermatology include Joint Photographic Experts Group (JPEG) and Tag Image File Format (TIFF). While each format has benefits, neither format naturally has security mechanisms to prevent unwanted access.[1] Regardless of format, all photographs should be encrypted and password-protected.[1]

Images should be kept on secure servers with strong access controls.[2] Dermatologists should avoid storing sensitive photos on personal devices because of the heightened danger of data breaches.[2] However, if a personal device is encrypted and includes adequate access control measures (eg, strong passwords, remote-wipe capability), it may be compliant with the Health Insurance Portability and Accountability Act (HIPAA). If photographs must be recorded on a smartphone, they should be uploaded to a secure server and the original deleted.[2] Additionally, employing secure cloud storage solutions with end-to-end encryption (E2EE) can help protect patient privacy as the sender securely codes data, which can only be decoded by the intended receiver.[2] Platforms like Microsoft Teams with Microsoft 365 Business or Dropbox Business offer HIPAA-compliant storage with E2EE.

In addition, photos automatically contain metadata stored with the image. Metadata refers to additional data embedded within an image file, including details such as the date and time the photo was taken, camera settings, geolocation data, and device information.[3] Geolocation data may be deactivated before pictures are taken by turning off the camera application's location services, or may be removed manually after a picture is taken.

Efficient naming conventions for images can aid in organization and retrieval while maintaining patient confidentiality.[4] A best practice is to avoid any patient-identifiable information in image names. Instead, practices can use anonymized codes that reference non-identifiable details, such as "IMG" followed by a unique number and brief descriptor (eg, "IMG1023_chest_BCC"). This method ensures that images are easily searchable while maintaining anonymity.[1,4]

For devices that use secure digital (SD) cards to store images, it is essential to implement best practices to prevent data loss or theft.[5] The SD cards should be encrypted, and access should be restricted to authorized personnel.[5] Furthermore, devices capturing images should have up-to-date security software.[2,5]

The use of digital imaging in dermatology provides tremendous benefits for patient care and education, but also raises serious privacy and security concerns.[1,2,5] Dermatologists can protect patient privacy while maximizing the benefits of digital imaging by implementing security measures such as encryption, secure HIPAA-compliant storage, and metadata management.[1,2,5] As technology advances, continual monitoring and adaptation of security policies will be required to protect sensitive patient information in dermatology.

DISCLOSURES

Dr Tolkachjov is a speaker and investigator for CASTLE Biosciences, Bioventus, Kerecis, and Boehringer Ingelheim. The other authors have no conflicts of interest to declare.

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LETTERS TO THE EDITOR

Journal of Drugs in Dermatology

Excimer Laser for Plaque Psoriasis: A Systematic Review and Meta-analysis

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INTRODUCTION

Plaque psoriasis is a chronic inflammatory condition characterized by keratinocyte hyperproliferation and immune dysregulation that significantly impacts quality of life.[1] While conventional therapies, such as topical corticosteroids and biologics, are frequently capable of stabilizing disease progression, their limitations, like adherence challenges and adverse effects,[2,3] necessitate alternative treatments. The 308 nm excimer laser utilizes site-specific UVB to induce DNA damage and apoptosis in treated cells, decreasing the inflammation and hyperproliferation characteristic of psoriasis.[4] Although excimer is an established treatment, current literature lacks a comprehensive meta-analysis quantifying the laser's efficacy. This review and meta-analysis seek to address this gap by synthesizing data from studies evaluating excimer laser treatment for plaque psoriasis.

MATERIALS AND METHODS

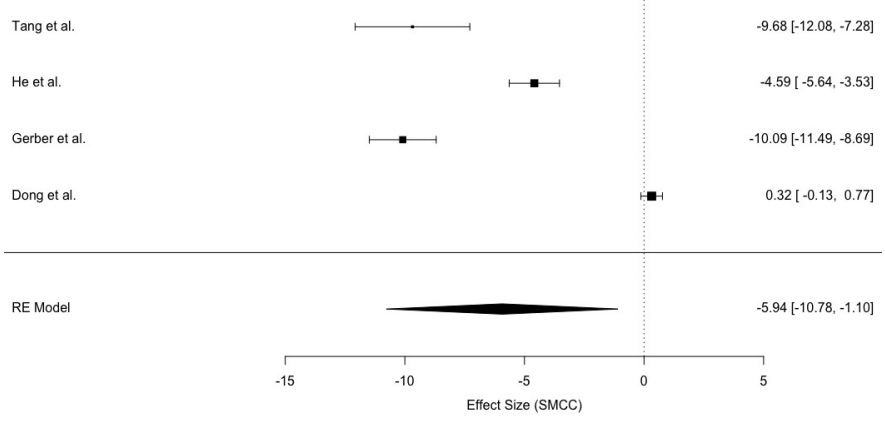
We searched MEDLINE, Embase, CENTRAL, and Web of Science using the search terms "psoriasis" and "laser". We included all clinical trials that utilized a 308 nm excimer laser for plaque psoriasis. Studies must have treated subjects twice weekly for at least 10 sessions. The Psoriasis Area and Severity Index (PASI) must have been the standardized measure used in included studies. A random-effects model was used to estimate standardized mean change with change score standardization (SMCC), which was used as the effect size to estimate the difference between baseline and follow-up PASI. A mixed-effects meta-regression was conducted to pool effect sizes across studies. All statistical analyses were performed in RStudio using the "metafor" package.

TABLE 1.

Characteristics of Included Studies

Study	Number of Subjects	Pulse Width (ns)	Initial Dose	Average Number of treatments	Frequency of treatments	Mean Pretreatment PASI (± SD)	Mean Posttreatment PASI (± SD)
Tang et al.	32	Not reported	3x MED	12	Twice weekly	11.47 (± 1.87)	5.08 (± 1.65)
He et al.	40	60	1-2x MED	13.7	Twice weekly	14.73 (± 4.37)	2.42 (± 2.91)
Gerber et al.	102	60	3x MED	10.8	Twice weekly	13.70 (± 2.1)	2.10 (± 1.2)
Dong et al.	20	60	1-2x MED	10	Twice weekly	12.02 (± 5.89)	4.09 (± 3.31)

FIGURE 1. Forest plot of SMCC of PASI scores.



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RESULTS

Our search identified 548 results, of which 4 met our inclusion criteria (Table 1). The heterogeneity analysis of the PASI dataset revealed significant variability among studies, with a high Cochran's Q (285.75, $P < 0.0001$) and I^2 of 98.95%, justifying the use of a random-effects model. The model produced an overall standardized mean change (SMCC) of -5.94 (95% CI: -10.78, -1.10), which indicates a significant reduction in PASI scores following excimer laser treatment ($z = -2.41$, $P = 0.0161$; Figure 1).

DISCUSSION

This review highlights the positive clinical response to the 308 nm excimer laser and quantifies the disease response. While previous reviews have aggregated data from studies on excimer's efficacy, to our knowledge, these findings have never been analyzed to quantify the disease response.[5] Our findings reinforce excimer's utility as an option for those unwilling or unable to treat large surface areas with topicals or biologic treatments. This study is limited by its small sample size. Further studies should evaluate a direct comparison to other treatments to elucidate which modality is most appropriate for this condition.

DISCLOSURES

The authors have no conflicts of interest to disclose.

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LETTERS TO THE EDITOR

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Real-World Effectiveness of Lebrikizumab for the Prurigo Nodularis–Like Phenotype of Atopic Dermatitis: A One-Year Retrospective Study

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To the Editor:

Atopic dermatitis (AD) presents with several phenotypes, among which the prurigo nodularis (PN)-like phenotype is particularly resistant to treatment.[1] PN-like phenotype of AD is characterized by multiple widespread pruritic nodules and intense and persistent itch, sometimes accompanied by pain.[1] Interleukin (IL)-13 is a type-2 cytokine that plays a central role in skin inflammation, barrier disruption, and pruritus associated with AD, including PN-like phenotype.[2]

Lebrikizumab is a high-affinity humanized immunoglobulin G4 monoclonal antibody that specifically inhibits IL-13. Clinical trials and real-world studies have demonstrated its effectiveness and good tolerability for moderate-to-severe AD.[3,4,5] However, data on the effectiveness of lebrikizumab are currently lacking for the PN-like phenotype of AD. Therefore, we retrospectively evaluated the effectiveness and safety of lebrikizumab in 26 patients aged ≥ 12 years with PN-like phenotype of AD who were treated for at least 4 weeks (up to 48 weeks) from May 2024 to July 2025. At baseline, all patients had ≥ 20 excoriated and hyperkeratotic nodules primarily on the trunk and extremities. Lebrikizumab was administered subcutaneously at 500 mg at weeks 0 and 2, followed by 250 mg every 2 weeks together with topical corticosteroids of moderate-to-strongest potency. After week 16, all patients received lebrikizumab every 4 weeks. Written informed consent was obtained from all patients.

Baseline features of patients are as follows: male 57.7%, aged mean ± standard deviation 58.3 ± 13.8 years; investigator global assessment (IGA) 3.4 ± 0.6, eczema area and severity index (EASI) 24.0 ± 9.2, peak pruritus numerical rating scale (PP-NRS) 7.1 ± 2.9, sleep quality NRS 6.7 ± 3.0, and dermatology life quality index (DLQI) 8.8 ± 6.5. Nine patients previously received systemic therapy (1 patient with baricitinib 4 mg, 3 with upadacitinib 15 mg, 1 with upadacitinib 30 mg, 2 with dupilumab, and 3 with tralokinumab).

EASI, PP-NRS, sleep quality NRS, and DLQI were assessed at weeks 4, 12, 16, 24, 36, and 48. All these scores rapidly decreased by week 12, thereafter plateaued or gradually decreased through week 48 (Figure 1). The rates achieving IGA 0/1, ≥ 4-point improvement of PP-NRS, ≥ 4-point improvement of sleep quality NRS, and DLQI 0/1 continued to increase and reached 50.0%, 64.3%, 80.0%, and 66.7%, respectively, at week 48 (Figure 1). Simultaneously, PN lesions became flattened and decreased over time in most patients. Mild-to-moderate conjunctivitis occurred in three patients. There were no serious adverse events or adverse events leading to discontinuation of lebrikizumab.

In conclusion, this study demonstrated the effectiveness and tolerability of lebrikizumab for the PN-like phenotype of AD. Limitations were the small sample size and inability to precisely track the number of PN-like lesions. Further investigation in larger cohorts with longer follow-up periods and precise counting of PN is required to confirm the long-term effectiveness of lebrikizumab for the PN-like phenotype of AD.

DISCLOSURES

Hidehisa Saeki, Teppei Hagino, and Naoko Kanda received lecture fees from Eli Lilly. The remaining authors report no conflicts of interest. Funding sources: This work is partly supported by 2025 scholarship grants from MaruhoTakagi Dermatology Foundation and Torii Pharmaceutical Co., Ltd. This study was conducted in accordance with the Declaration of Helsinki and approved by the Ethics Committees of Nippon Medical School Chiba Hokusoh Hospital and Nippon Medical School. Written informed consent was obtained from all participants. Data availability statement: The data that support the findings of this study are available from the corresponding author upon reasonable request.

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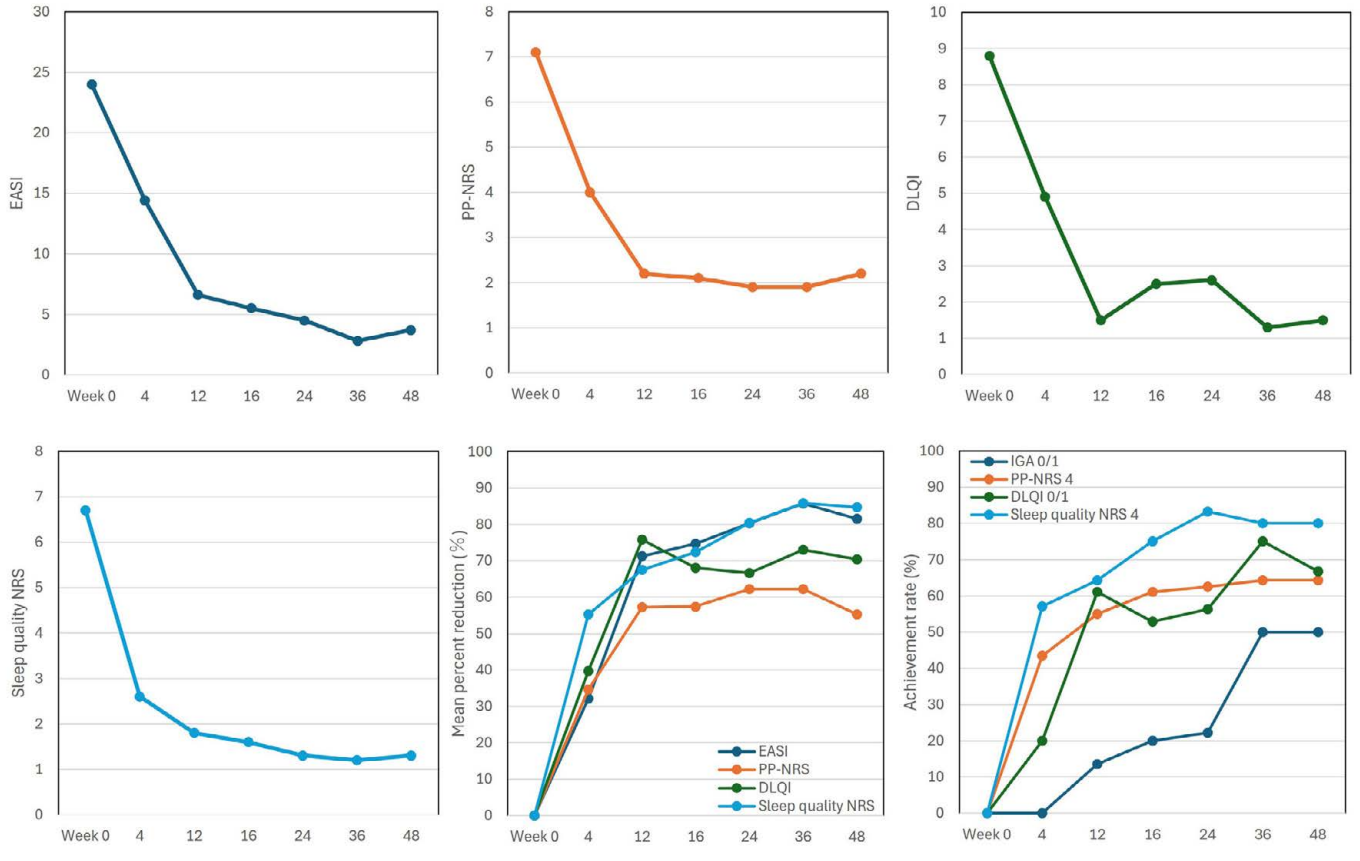
FIGURE 1. Clinical responses to lebrikizumab in patients with prurigo nodularis–like phenotype of atopic dermatitis (n = 26) during 48-week



Data are transition of mean eczema area and severity index (EASI), mean peak pruritus numerical rating scale (PP-NRS), mean dermatology life quality index (DLQI), mean sleep quality numerical rating scale (sleep quality NRS), mean percent reductions of EASI, PP-NRS, DLQI, and sleep quality NRS from baseline, and achievement rates of investigator global assessment (IGA) 0/1, ≥ 4-point reduction of PP-NRS (PP-NRS4), DLQI 0/1, and ≥ 4-point reduction of sleep quality NRS (sleep quality NRS4).

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NEWS, VIEWS, AND REVIEWS

The Senile Cell: Understanding Cellular Senescence in Dermatology

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INTRODUCTION

Cellular senescence is a permanent and stable arrest of the cell cycle triggered by endogenous and exogenous stressors, such as DNA damage, oxidative stress, and telomere dysfunction.[1,2] In this state, cells are unable to proliferate despite favorable growth conditions and often exhibit increased resistance to apoptosis through upregulation of cell survival pathways.[1] Additionally, senescent cells may influence the surrounding environment through the senescence-associated secretory phenotype (SASP), which consists of inflammatory cytokines, chemokines, growth factors, and proteases.[3,4] Cellular senescence and SASP play key roles in skin aging and are thought to contribute to dermatoporosis, an age-related condition that primarily affects chronically sun-exposed areas, such as the forearms.[5] Dermatoporosis is characterized by skin atrophy and increased skin fragility, susceptibility to skin tears, secondary infection, and delayed wound healing[5-7] (Figure 1).

Figure 1. Clinical presentation of dermatoporosis of the left hand and forearm.



In response to the growing recognition of senescence-driven pathology, emerging research has focused on senotherapeutics, a field focused on targeting cellular senescence.[8] Here we review the role of cellular senescence and SASP in skin aging and examine potential senotherapeutic agents. We also discuss commonly used topical treatments, including hyaluronic acid (HA), retinoids, vitamin C, niacinamide, and alpha hydroxy acids (AHAs), to inform clinical strategies for addressing cellular senescence in skin aging.

Cellular Senescence and SASP

Cellular senescence plays a key role in both intrinsic and extrinsic skin aging. Intrinsic aging primarily occurs in sun-protected areas, resulting in epidermal thinning, loss of subcutaneous fat, and reduced dermal thickness.[2,9] Extrinsic aging is largely driven by chronic sun exposure, leading to a loss of collagen and dermal extracellular matrix.[9] Both intrinsic and extrinsic aging contribute to the accumulation of senescent cells, driving structural and functional changes in the skin.[10] Skin biopsies from older individuals reveal increased frequency of senescent cell markers, specifically $p16^{INK4A}$, a cell cycle checkpoint protein, and senescence-associated β-galactosidase (SA-βgal) expression, a lysosomal enzyme.[2,9,11]

Senescent cells also influence skin aging and tissue regeneration through paracrine signaling via SASP.[1,10] Similar to senescent cells, SASP increases with age and can alter the tissue microenvironment through collagen degradation and chronic inflammation, leading to visible features of aging such as sagging, wrinkles, and skin laxity.[8,9] Although senescent cells and SASP contribute to skin aging, they also play beneficial roles in certain physiological contexts, including embryonic development, suppressing cancer cell proliferation, and aiding in wound healing by limiting excessive cell growth, fibrosis, and granulation tissue formation.[8,9]

Senotherapeutics

Senotherapeutics, including senolytics and senomorphics, have emerged as a promising strategy for treating age-related disease and restoring skin tissue structure and function.[2,8] Senolytics are currently under investigation for their potential to induce cell death in senescent cells.[8] Several classes of senolytic compounds have been investigated, including tyrosine kinase inhibitors, B-cell lymphoma-2 (BCL-2) inhibitors, and FOXO4-DRI peptide.[8] However, many senolytic agents lack cell-type specificity, leading to off-target effects and toxicity in healthy tissues.[8] As a result, further research is needed to optimize dosing strategies and enhance tissue-specific targeting.[8]

Senomorphics modulate senescent cell behavior by suppressing or altering SASP rather than eliminating senescent cells. Examples include mammalian target of rapamycin (mTOR) inhibitors, Janus kinase (JAK) inhibitors, and nuclear factor kappa B (NF-κB) inhibitors.[8] Although senotherapeutics have promise, they are not yet approved for clinical use.[2] Potential side effects and safety profile of long-term treatment need to be evaluated prior to clinical application in dermatology.[2,8]

Over-the-Counter Topicals and Retinoids

While senotherapeutics remain experimental, several agents such as HA, retinoids, vitamin C, niacinamide, and AHAs have been studied for their effects on cellular senescence and the clinical manifestations of skin aging and dermatoporosis.

HA is the most abundant glycosaminoglycan in the skin and is a major component of the extracellular matrix.[5] However, HA and CD44 levels, a transmembrane receptor essential for HA synthesis, decline markedly in aging skin.[5] In a study of patients with dermatoporosis, reduced HA and CD44 expression were observed in both the epidermis and dermis and were accompanied by significantly increased epidermal expression of $p16^{INK4A}$.[5,6] Following one month of twice-daily topical treatment of the forearm with a combination cream containing 1% intermediate size hyaluronate fragments (HAFi) and 0.05% retinaldehyde (RAL), patients exhibited a significant reduction in $p16^{INK4A}$-positive cells in both the dermis and epidermis, along with measurable clinical improvement in skin thickness by ultrasonography.[6] Retinoids, including RAL, are vitamin A derivatives that promote epidermal barrier function, collagen synthesis, keratinocyte proliferation, and inhibit transepidermal water loss (TEWL) and matrix metalloproteinase (MMP) activity.[5] Prescription tretinoin was evaluated in a 16-week randomized, double-blind study comparing 0.1% topical tretinoin cream with a vehicle control.[12] Tretinoin significantly improved photoaging on the treated face and forearm, with histologic evidence of increased epidermal and granular layers.[12]

Vitamin C (ascorbic acid) is an antioxidant that is implicated in the treatment of aging skin by reducing reactive oxygen species, increasing dermal thickness, and downregulating MMPs responsible for collagen degradation.[5] In a double-blind, randomized study, twice daily application of 5% topical vitamin C for 12 weeks revealed clinical improvement in skin elasticity and thickness and a reduction of hemorrhagic lesions associated with dermatoporosis.[13] Ascorbic acid 2-glucoside, a vitamin C derivative, has even been shown to downregulate SA-β-gal activity.[5] Niacinamide, a vitamin B3 derivative, exhibits anti-inflammatory and antioxidant properties, reducing proinflammatory cytokines such as IL-1α, IL-6, and IL-8, which are implicated in SASP.[5] Niacinamide has also been shown to delay cellular senescence and stimulate the production of collagen, glycosaminoglycans, and other dermal matrix components.[5]

AHAs, specifically mandelic acid, have been investigated for the treatment of senescence-associated dermatoporosis.[7] In vitro studies demonstrated that concentrations of 0.05% mandelic acid and 0.005% *Centella asiatica*, a botanical extract, reduced SASP expression in keratinocytes.[7] In an ex vivo photodamaged skin model, immunofluorescence analysis demonstrated reduced $p16^{INK4A}$ expression in the papillary dermis following treatment, whereas untreated samples retained senescent cells.[7] A follow-up study evaluated twice-daily application of mandelic acid and *Centella asiatica* combination cream in 54 adults with self-reported sensitive skin and dermatoporosis.[14] At 12 weeks, treatment of both forearms and one leg, with the contralateral leg serving as an untreated control, demonstrated significantly improved hydration, increased skin thickness of the epidermal, dermal, and subdermal layers, and reduced TEWL.[14] No adverse reactions were reported, and both clinical assessment and participant reports noted improved skin texture and overall skin quality.[14]

CONCLUSION

Cellular senescence plays a key role in skin aging and age-related dermatologic conditions. Senotherapeutics represent a promising and rapidly evolving area of research, however, their clinical application in dermatology remains limited and requires further investigation to establish safety and efficacy. In contrast, several commonly used topical agents, particularly HA, retinoids, vitamin C, niacinamide, and AHAs have been studied in the context of cellular senescence and age-related cutaneous changes, specifically for preventing and managing dermatoporosis. Together, these findings highlight the role of established topical therapies as accessible, adjunctive strategies for addressing the clinical consequences of cutaneous cellular senescence while senotherapeutic approaches continue to evolve.

DISCLOSURES

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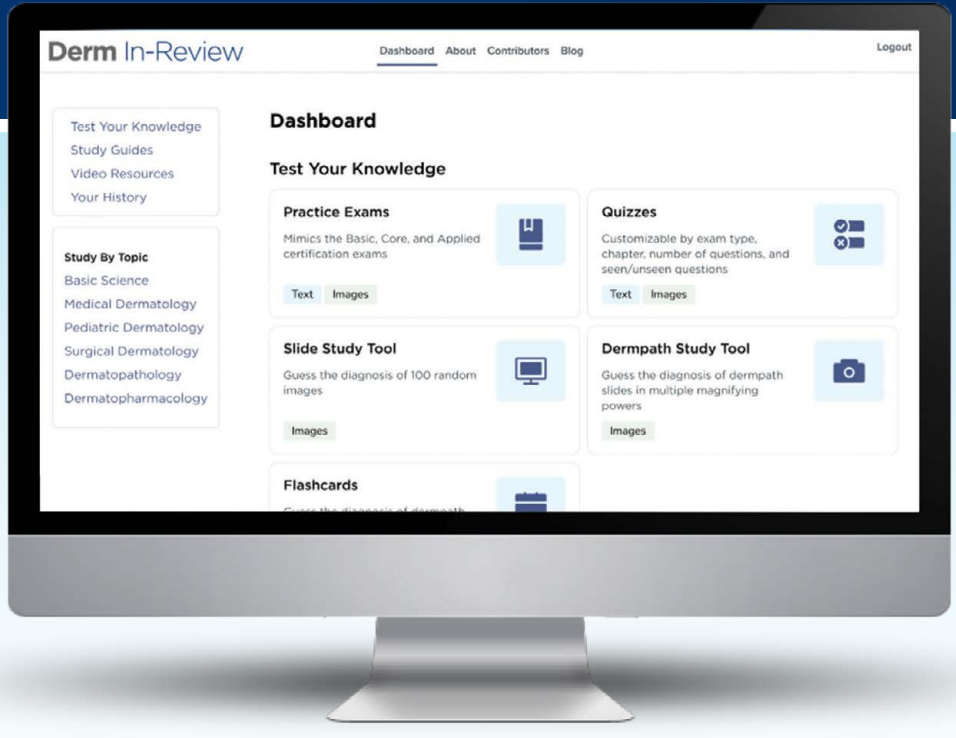

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