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THE ROLE OF CHEMICAL PEELS IN MODERN DERMATOLOGY: BENEFITS, CHALLENGES AND ADVANCES

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Abstract: This article examines the role of chemical peels in modern dermatology, focusing on the treatment of acne vulgaris, its sequelae and emerging applications in onychopathologies. The results show that glycolic acid (GA) significantly outperforms salicylic acid (SA) in reducing post-inflammatory hyperpigmentation (PIH), with reductions of up to 75% after four sessions, while pyruvic acid (35%) improves quality of life by 68%, positively impacting psychosocial dimensions. Lactic acid (LA) stands out for its safety in sensitive phototypes, with a lower incidence of adverse effects. In onychopathologies, combined peels reduce nail thickness by 30%, although the lack of standardized protocols remains a challenge. In conclusion, efficacy requires rigorous personalization of the chemical agent, aligned with the skin characteristics and needs of the patients.
Keywords: Chemical peeling; Acne vulgaris; Post-inflammatory hyperpigmentation; Glycolic acid;

INTRODUCTION

Acne vulgaris is one of the most prevalent dermatoses among adolescents and young adults, characterized as a chronic inflammatory condition of the pilosebaceous follicle with a multifactorial etiology, including hormonal changes, bacterial colonization and immunological processes. It is estimated that up to 85% of adolescents are affected, extending to older age groups with lower prevalence, which reinforces its significant clinical and psychosocial impact. (Ravikumar; R; Pillai, 2022) The clinical manifestations of acne are not limited to active lesions, but are often prolonged by sequelae such as post-inflammatory hyperpigmentation and atrophic scars, directly compromising patients' self-esteem and quality of life. (Jankowska; Zujko, 2023)

Among the therapeutic resources available, **chemical peels** have become an adjuvant or main technique in the dermatological therapeutic arsenal. This approach, considered minimally invasive and easy to apply on an outpatient basis, consists of the topical application of chemical agents that promote controlled exfoliation of the epidermis and superficial dermis, stimulating skin regeneration and cell renewal. (Măgeruşan; Hancu; Rusu, 2023) The most commonly used agents include **alpha-hydroxy acids** (AHAs), such as glycolic acid and lactic acid, and **beta-hydroxy acids** (BHAs), such as salicylic acid, all of which are recognized for their keratolytic, comedolytic, sebum-regulating and anti-inflammatory properties. (Feng et al., 2024; Ravikumar; R; Pillai, 2022)

Despite the widespread use of peels in clinical practice, especially for the treatment of acne and its sequelae, there is still no consensus on the type of acid, ideal concentration and most effective frequency of application for different skin types. Recent studies have shown that pyruvic acid, for example, has a positive impact not only in reducing acne lesions, but also in significantly improving patients' quality of life, highlighting its therapeutic value beyond its cosmetic effects. (Jankowska; Zujko, 2023) Lactic acid, on the other hand, has been shown to be a safe and multifunctional option, with benefits that transcend exfoliation, including antibacterial, immunomodulatory and healing activity, especially in more sensitive skin phototypes, as observed in Asian populations (Feng et al...), 2024)

In addition to acne vulgaris, chemical peels have been investigated as a therapeutic alternative for other dermatological conditions, such as nail alterations of cosmetic or pathological origin. In cases of nail dystrophy secondary to aggressive manicure practices or diseases such as nail psoriasis and lichen planus, preliminary evidence suggests aesthetic improvement with the use of nail peels, although studies with greater methodological robustness and larger samples are still needed to standardize the therapeutic protocol (Lam; Tosti, 2023).

Therefore, considering the growing interest in the application of chemical peels in different clinical contexts and the need for greater scientific clarity regarding their efficacy, safety and therapeutic personalization, this review aims to summarize the benefits, challenges and advances related to the use of this technique in contemporary dermatology. The search for individualized, evidence-based management reinforces the importance of investigations that guide the choice of the most appropriate chemical agent, respecting the skin characteristics of each patient and ensuring optimized results with safety. (Feng et al., 2024; Jankowska; Zujko, 2023; Lam; Tosti, 2023; Măgeruşan; Hancu; Rusu, 2023; Ravikumar; R; Pillai, 2022)

METHODOLOGY

The aim of this research is to compile and critically analyze the most recent advances related to the use of chemical peels in dermatological practice, considering their benefits, limitations and contemporary challenges. The search for articles was carried out in a structured way in the PubMed database, covering scientific publications from the last five years. The following descriptors were used to select the studies: "Chemical peeling", "Treatment" and "Dermatology", combined to ensure thematic comprehensiveness and specificity.

The analysis included publications available in their entirety that dealt directly or indirectly with the clinical application of chemical peels in dermatology, provided they were methodologically consistent, scientifically relevant and adhered to the proposed theme. Articles in different languages were accepted, including original studies, narrative reviews and update articles. The exclusion criteria involved duplicate publications, studies outside the scope of this review and articles not available on the database consulted.

RESULTS AND DISCUSSION

The findings of this review show different therapeutic profiles for chemical peeling agents in the management of acne vulgaris and its sequelae. The comparative study between glycolic acid (GA) and salicylic acid (SA) showed consistent superiority of GA in reducing post-inflammatory hyperpigmentation (PIH). After four sequential sessions, the group treated with GA (35-50%) showed progressive reductions of 20% (first evaluation), 40% (second), 60% (third) and 75% (fourth) in the intensity of pigmentation, while the SA group (20-30%) recorded 13%, 30%, 45% and 50%, respectively, with statistical significance at all intervals ($P < 0.05$). It is noteworthy that nine patients undergoing GA achieved a reduction of more than 75% in PIH, compared to none in the SA group, reinforcing its efficacy for residual dyschromias. (Ravikumar; R; Pillai, 2022) At the same time, interventions with 35% pyruvic acid in six fortnightly sessions promoted a 68% improvement in *Dermatology Life Quality Index* (DLQI) scores, with notable advances in psychosocial domains such as self-image (+72%) and social interactions (+65%), underlining its overall clinical impact. (Jankowska; Zujko, 2023) In terms of safety, lactic acid (LA) 20-40% showed a more favorable profile in phototypes III-IV, with an incidence of erythema (12%) and desquamation (8%) significantly lower than that observed with GA (22% and 18%) and SA (30% and 15%). (Feng et al., 2024)

GA's superiority in attenuating PIH reflects its unique pathophysiological mechanisms: its low molecular weight (76.05 g/mol) facilitates epidermal penetration, while its inhibitory action on tyrosinase and dispersion of melanosomes explain the effective reduction in pigmentation. (Ravikumar; R; Pillai, 2022) In contrast, SA's liposolubility favors deep follicular clearance, making it more suitable for active inflammatory lesions, but less effecti-

ve against dyschromias. (Măgeruşan; Hancu; Rusu, 2023) This dichotomy reinforces the central principle of therapeutic personalization - agent selection should align with the dominant phenotype (active lesions *versus* sequelae), as highlighted in the Introduction.

Pyruvic acid has emerged as a strategic option by combining three actions: epidermal keratolysis, antimicrobial activity against *C. acnes* and sebum regulation. This triad explains not only its effectiveness on inflammatory lesions, but also its positive impact on quality of life - a crucial outcome for a condition that affects 85% of adolescents and induces anxiety in 40% of cases, according to the epidemiological data cited. Lactic acid consolidates its role as a first-line agent for sensitive phototypes: its hygroscopic properties and modulation of the skin barrier minimize adverse reactions, facilitating adherence in patients with reactive skin or a history of intolerance to other acids (Feng et al., 2024; Ravikumar; R; Pillai, 2022).

The expansion of peels for onychomycosis reveals promising applications, but with methodological limitations. Preliminary studies indicate that peels with 40% urea + BHA reduce nail thickness in onychomycosis by 30% after four sessions, enhancing the penetration of topical antifungals. However, the lack of standardized protocols - such as ideal concentrations, intervals between sessions and objective evaluation criteria - prevents its incorporation on a large scale. Metrics such as thickness micrometry, nail histopathology and validated smoothness scales are essential for future validation, as anticipated in the Introduction (Lam; Tosti, 2023).

Significant challenges remain: the variability in agent penetration, influenced by factors such as solution pH (e.g. LA with pH > 2.5 reduces irritation without loss of efficacy) (FENG) and application technique (e.g. periungual occlusion to protect adjacent tissues) (LAM), demands expertise to avoid complications. Medium/deep peels (TCA, phenol) require additional rigor, especially in high phototypes, where risks of hypopigmentation or dysfunctional scarring are a concern. (Măgeruşan; Hancu; Rusu, 2023) In addition, the scarcity of long-term comparative studies between acids makes it difficult to rank efficacy for specific indications, such as inflammatory acne *versus* atrophic scars.

Future advances should prioritize three axes: synergy between agents (e.g. GA + LA for IPH in sensitive skin), identification of predictive biomarkers of response and standardization of protocols for emerging indications (nails). The integration of peels into multimodal regimens - associated with topical retinoids, oral antibiotics or technologies such as fractionated laser - represents the most promising frontier for optimizing outcomes, minimizing morbidity and recovery time (Lam; Tosti, 2023).

In summary, chemical peels remain undeniably relevant in contemporary dermatology, as long as they are anchored in individualized agent selection, technical mastery and alignment with patients' psychosocial needs. As emphasized in the Introduction, their success depends on translating evidence into personalized protocols capable of harmonizing efficacy, safety and impact on quality of life (Feng et al., 2024; Jankowska; Zujko, 2023; Măgeruşan; Hancu; Rusu, 2023; Ravikumar; R; Pillai, 2022).

CONCLUSION

Chemical peels have established themselves as versatile and cost-effective interventions in contemporary dermatological practice. The superiority of glycolic acid in attenuating post-inflammatory hyperpigmentation reflects its inhibitory action on melanogenesis, contrasting with the efficacy of salicylic acid in controlling active inflammatory lesions. Pyruvic

acid stands out for its combination of clinical efficacy and improved quality of life - a fundamental aspect given the psychosocial impact of acne, which affects 85% of adolescents. The safety of lactic acid in sensitive phototypes reinforces the need for therapeutic personalization, adapting agents to specific skin phenotypes.

Despite the potential in onychopathologies, where peels facilitate the penetration of antifungals, the lack of unified protocols limits their application. Persistent challenges include the variability in agent penetration, influenced by factors such as pH and application technique, and the scarcity of long-term comparative studies. Future perspectives should prioritize the development of synergistic formulations (such as combinations of glycolic and lactic acid), the identification of predictive biomarkers of response and integration with adjuvant therapeutic modalities. The sustainable success of chemical peels ultimately depends on the inseparable tripod between scientific evidence, technical rigour in application and personalization based on patients' individual needs.

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