



Systematic Review Article

ROLE OF CHEMICAL PEELS IN THE MANAGEMENT OF ACNE SCARS: A SYSTEMATIC REVIEW

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ABSTRACT

Background: Acne scarring is a frequent sequela of acne vulgaris with significant cosmetic and psychosocial impact. Chemical peels promote controlled skin exfoliation and collagen remodeling and are widely used due to their affordability and accessibility. However, evidence regarding their efficacy across different peel agents, depths, and scar types remains inconsistent, necessitating a systematic evaluation of existing literature. **Objective:** To systematically review and synthesize clinical evidence on the efficacy and safety of chemical peels for acne scars, following PRISMA 2020 guidance. **Materials and Methods:** This systematic review was conducted in accordance with PRISMA 2020 guidelines. A comprehensive literature search was performed in PubMed/MEDLINE, PMC/NIH, the Cochrane Central Register of Controlled Trials, and Google Scholar. Randomized controlled trials (RCTs), controlled clinical trials, prospective cohort studies, and comparative observational studies, review articles evaluating chemical peels for acne scars were included. Eligible studies reported at least one objective or validated clinical outcome. Non-English studies without extractable data and studies lacking clear outcome measures, editorials, commentaries, Conference abstracts, were excluded. Sixteen studies met inclusion criteria and were synthesized narratively due to heterogeneity.

Results: Sixteen studies evaluating glycolic acid, salicylic acid, trichloroacetic acid (TCA) (including CROSS {Chemical Reconstruction of Skin Scars}), Jessner's solution, phenol peels, and combination modalities were included. TCA-CROSS demonstrated the greatest efficacy for ice-pick scars, while salicylic acid and glycolic acid peels were beneficial for mild atrophic scars and post-inflammatory hyperpigmentation. Medium-depth and combination approaches, including subcision and microneedling, showed improved outcomes for boxcar and rolling scars compared with superficial peels alone. Higher concentrations of TCA achieved greater improvement but were associated with increased adverse effects. Overall, chemical peels were effective and generally safe, including in darker skin types, with transient pigmentary changes being the most common adverse event.

Conclusions: Chemical peels are effective for acne scars when selected by scar type. TCA-CROSS is most effective for ice-pick scars, superficial peels benefit mild atrophic scars and hyperpigmentation, and combination therapies improve boxcar and rolling scars. Overall safety is acceptable, though higher TCA concentrations increase adverse effects. Larger, standardized RCTs with validated scar-grading scales and objective imaging are recommended.

Keywords: chemical peels, glycolic acid, salicylic acid, trichloroacetic acid, Jessner's solution, phenol, acne scars.

INTRODUCTION

Acne scarring is a common and often distressing sequela of acne vulgaris, associated with significant psychosocial burden and long-term cosmetic concern. Various treatment modalities have been employed for the management of acne scars, including laser therapies, microneedling, subcision, dermal fillers, and chemical peels. Chemical peels, using agents such as alpha-hydroxy acids, beta-hydroxy acids, trichloroacetic acid, and phenol, act by inducing controlled chemical exfoliation of the skin, promoting collagen remodeling and epidermal regeneration. Owing to their relative affordability, ease of administration, and suitability for diverse skin types, chemical peels remain widely used in clinical practice, particularly in resource-limited settings. However, the effectiveness of different peeling agents, depths of peels, and treatment protocols in improving various types of acne scars remains variable, and evidence is dispersed across heterogeneous studies. A comprehensive synthesis of available literature is therefore necessary to evaluate the role of chemical peels in the management of acne scars.

MATERIALS AND METHODS

Database search

A comprehensive literature search was conducted in PubMed/MEDLINE, PMC/NIH, the Cochrane Central Register of Controlled Trials, and Google Scholar using key words chemical peels, glycolic acid, salicylic acid, trichloroacetic acid, Jessner's solution, phenol, and acne scars. Reference lists of eligible studies and relevant reviews were manually screened to identify additional publications. The study selection process was documented using a PRISMA 2020 flow diagram.

Eligibility Criteria

Inclusion criteria: randomized controlled trials (RCTs), controlled clinical trials, prospective cohort studies, or comparative observational studies that evaluated chemical peels (any agent and concentration) applied for treatment of acne scars, with at least one objective or validated clinical outcome (scar grade, investigator/patient global assessment, or imaging). Reviews/systematic reviews were included to identify primary studies.

Exclusion criteria: non-English papers without extractable data, Lacked clear outcome measures or evaluable results, editorials, commentaries, Conference abstracts, were excluded.

Titles, abstracts, and full texts were independently screened by two reviewers, with disagreements resolved by consensus. Data extraction and quality assessment were performed independently using standardized tools appropriate to study design. Due to heterogeneity among studies, a qualitative synthesis was conducted.

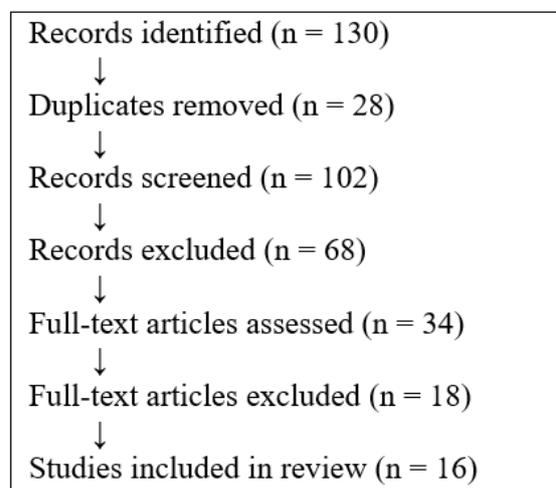


Figure: PRISMA Flow Diagram of Study Selection Process

RESULTS AND DISCUSSION

Table 1: Grades of post acne scarring (Goodman GJ et al., 2006).^[1]

Grades of Post Acne Scarring	Level of disease	Clinical features
1	Macular	These scars can be erythematous, hyper- or hypopigmented flat marks. They do not represent a problem of contour like other scar grades but of color.
2	Mild	Mild atrophy or hypertrophy scars that may not be obvious at social distances of 50 cm or greater and may be covered adequately by makeup or the normal shadow of shaved beard hair in men or normal body hair if extrafacial.
3	Moderate	Moderate atrophic or hypertrophic scarring that is obvious at social distances of 50 cm or greater and is not covered easily by makeup or the normal shadow of shaved beard hair in men or body hair if extrafacial, but is still able to be flattened by manual stretching of the skin (if atrophic).
4	Severe	Severe atrophic or hypertrophic scarring that is evident at social distances greater than 50 cm and is not covered easily by makeup or the normal shadow of shaved beard hair in men or body hair if extrafacial and is not able to be flattened by manual stretching of the skin.

Acne scarring remains a frequent complication of acne, with no single definitive treatment available. The chemical reconstruction of skin scars (CROSS) technique involves targeted application of high-

concentration trichloroacetic acid to depressed atrophic scars to promote dermal remodeling (Lee JB et al., 2002).^[2]

A wide range of treatment options exists, including chemical peels, dermabrasion, laser therapies, punch techniques, needling, and combination approaches (Fabbrocini G et al., 2010).^[3]

Types of Peels

Glycolic acid peels have been widely used for acne, scarring, and hyperpigmentation, predominantly in lighter skin types. Salicylic–mandelic acid combination peels represent a newer approach with limited comparative evidence. In Indian patients, both modalities were found to be safe and effective; however, salicylic–mandelic peels demonstrated superior outcomes for active acne and post-acne hyperpigmentation (Garg VK et al., 2009).^[4]

Pulsed dye laser reduces acne-related erythema by targeting superficial vessels, while salicylic acid peels provide comedolytic and anti-inflammatory effects. This study evaluated the safety and efficacy of combined pulsed dye laser and salicylic acid peels versus salicylic acid peels alone in moderate to severe acne vulgaris (Lekakh O et al., 2015).^[5]

Puri N, 2015, study shows that In Group I (Jessner's peel plus 20% TCA), mild, moderate, and marked improvement was observed in 8%, 32%, and 60% of patients, respectively. In Group II (20% TCA alone), corresponding improvements were seen in 32%, 40%, and 28% of cases. Overall differences between the two groups were not statistically significant ($P > 0.05$).^[6]

The clinical improvement observed with chemical peels appears to result from dermal structural reorganization along with increased dermal volume, with these changes being more prominent following deeper peels (Butler PE et al., 2001).^[7]

Rullan PP et al., 2020, studied one hundred thirty-nine patients, predominantly with Fitzpatrick skin types IV–VI, underwent an average of two treatment sessions. Outcomes assessed by standardized photography and patient feedback showed high satisfaction and visible improvement. The combined use of CROSS, subcision, and microneedling appears effective for acne scars, though larger randomized trials are needed for confirmation.^[8]

Roy G et al., 2024 studied that the greatest clinical improvement was observed with 65% trichloroacetic acid, although this concentration was associated with a higher incidence of adverse effects, particularly acneiform eruptions not commonly reported previously. Glycolic acid demonstrated a safer profile with satisfactory outcomes, suggesting its potential as an alternative CROSS agent and warranting further evaluation across varying concentrations.^[9]

Once the benchmark for deep facial resurfacing, the traditional Baker–Gordon phenol–croton oil peel has evolved into formulations with reduced phenol and croton oil concentrations, offering improved safety.

Advances in technique now allow controlled depth of penetration, as demonstrated by Hetter, who showed that croton oil concentration determines peel strength. Modern deep peels achieve wrinkle reduction and skin tightening with more natural outcomes and fewer pigmentary sequelae (Wambier CG et al., 2019).^[10]

Randomized control trial by Kessler E et al., 2008, found that both chemical peels demonstrated significant clinical improvement by the second session ($p < 0.05$), with no meaningful difference in overall efficacy between them. At two months post-treatment, salicylic acid peels showed more sustained benefits, while glycolic acid peels were associated with a higher rate of early adverse effects.^[11]

Serial peel testing showed that higher phenol concentrations without croton oil increased cutaneous reaction but produced minimal peeling. In contrast, combining croton oil with 50% phenol resulted in significantly deeper dermal peeling, with healing time directly related to croton oil concentration. Lower croton oil levels produced shallower injury and faster recovery, indicating that croton oil is the primary determinant of peel depth rather than phenol (Hetter GP et al., 2000).^[12]

Medium-depth chemical peeling represents a therapeutic approach between superficial trichloroacetic acid peels and deep phenol-based procedures. The use of solid carbon dioxide in combination with trichloroacetic acid enhances controlled epidermal injury and dermal regeneration. This technique has been applied in the management of actinic damage, acne scars, wrinkles, and pigmentary disorders (Brody HJ et al., 1986).^[13]

The photoaging index helps determine the level of rejuvenation required for visible aging changes. Mild photoaging responds to topical skincare and superficial peels, moderate changes benefit from light-to-medium peels with microdermabrasion, and advanced photoaging may require Jessner–TCA peels, laser resurfacing, or modified phenol peels. Combined use of skincare, chemical peels, lasers, and dermabrasion can effectively improve photoaged skin (Fulton JE et al., 2004).^[14]

Al-Waiz MM et al., 2002, studied that patients exhibited mixed atrophic and ice-pick acne scars. Improvement was seen in all but one patient, with over half achieving moderate improvement and better responses in those with moderate-depth atrophic scars. Patients with predominantly deep pitted scars showed limited benefit. Transient post-inflammatory hyperpigmentation was common but resolved within three months. Overall, medium-depth chemical peeling was safe and effective for acne scars, even in darker skin types.^[15]

Table 2: Overview of Included Studies and Key finding

Study	Peel / Modality	Study Population	Key Findings
Garg VK et al., 2009 ⁴	Glycolic acid vs Salicylic–mandelic peels	Indian patients with acne, post-acne hyperpigmentation	Both effective and safe; salicylic–mandelic peels superior for active acne and post-acne hyperpigmentation
Lekakh O et al., 2015 ⁵	Salicylic acid peel ± Pulsed dye laser	Moderate–severe acne vulgaris	Combination therapy more effective than peel alone for acne and erythema
Puri N, 2015 ⁶	Jessner’s + 20% TCA vs 20% TCA	Acne scars	Marked improvement higher with combination (60% vs 28%), but difference not statistically significant (P > 0.05)
Butler PE et al., 2001 ⁷	Chemical peels (varied depth)	Acne scars	Improvement attributed to dermal reorganization and increased dermal volume; greater effect with deeper peels
Rullan PP et al., 2020 ⁸	CROSS + subcision + microneedling	Fitzpatrick IV–VI	High patient satisfaction and visible improvement
Roy G et al., 2024 ⁹	TCA-CROSS (65%) vs GA-CROSS	Atrophic acne scars	65% TCA most effective but higher adverse events; GA safer with acceptable results
Wambier CG et al., 2019 ¹⁰	Reduced phenol–croton oil peels	Facial resurfacing	Reduced phenol/croton oil improves safety with controlled depth and natural outcomes
Kessler E et al., 2008 ¹¹	Salicylic acid vs Glycolic acid peels	Acne vulgaris	Both effective by 2nd session; SA showed sustained benefit; GA had more early adverse effects
Hetter GP et al., 2000 ¹²	Phenol–croton oil peels	Facial resurfacing	Peel depth determined by croton oil concentration, not phenol
Brody HJ et al., 1986 ¹³	CO ₂ + TCA (medium-depth peel)	Acne scars, wrinkles, pigmentation	control epidermal injury and dermal regeneration
Fulton JE et al., 2004 ¹⁴	Photoaging-guided peel selection	Photoaged skin	Peel depth tailored to severity improves outcomes
Al-Waiz MM et al., 2002 ¹⁵	Medium-depth chemical peels	Mixed atrophic & ice-pick scars	Moderate improvement most common; post inflammatory hyperpigmentation transient and resolved

Dermal chemical peeling is a well-tolerated and effective resurfacing procedure with high patient and physician satisfaction. While it does not achieve the deep tissue ablation possible with dermabrasion or lasers, trichloroacetic acid (TCA) peels offer reliable skin improvement with minimal complications and short recovery time. Patients typically experience visible and photographically appreciable enhancement, with results that are durable for years, often eliminating the need for repeat treatment for at least two years. Overall, dermal peeling provides an excellent balance between clinical benefit and procedural risk among resurfacing options (Coleman WP, 2001).^[16]

CONCLUSION

This systematic review demonstrates that chemical peels remain a safe, versatile, and effective modality for the management of acne, acne scars, post-acne hyperpigmentation, and photoaging, with outcomes strongly influenced by peel depth, concentration, and combination strategies. Superficial peels such as glycolic acid, salicylic acid, and salicylic–mandelic formulations consistently provide meaningful improvement in active acne and post-acne hyperpigmentation, with salicylic-based peels showing superior and more sustained efficacy and a favorable safety profile in darker skin types.

For atrophic acne scars, particularly ice-pick scars, TCA-CROSS and medium-depth peels demonstrate greater efficacy through dermal remodeling and control epidermal injury, although higher concentrations are associated with increased adverse effects. Evidence increasingly supports combination

approaches—including CROSS with subcision, microneedling, or laser modalities—as they yield higher patient satisfaction and more visible clinical improvement compared with monotherapy.

Deeper peels, including phenol–croton oil formulations, allow controlled dermal penetration and significant resurfacing benefits when carefully tailored, emphasizing the importance of individualized peel selection based on scar morphology, skin type, and photoaging severity. Overall, the findings highlight that patient-specific, depth-guided, and combination-based peel strategies optimize outcomes while maintaining safety, reinforcing the role of chemical peels as a cornerstone in comprehensive acne and scar management.

Overall, chemical peels demonstrate an acceptable safety profile across skin types, though higher TCA concentrations increase adverse effects, underscoring the need for individualized treatment selection and further high-quality comparative trials.

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