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To Study the Effect of Chemical Peeling in Various Dermatological Conditions

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Abstract: ***Introduction****: Chemical peeling is a widely utilized dermatological procedure for conditions such as acne, hyperpigmentation, melasma, and photoaging. It involves the controlled application of chemical agents to induce epidermal exfoliation and dermal regeneration, improving skin texture and pigmentation. Despite its effectiveness, variations in response and the potential for adverse effects necessitate further clinical evaluation. This study aims to assess the efficacy and safety of chemical peeling in various dermatological conditions.* ***Methodology****: A prospective, interventional study was conducted at department of dermatology in Rama Medical College Hospital and Research Centre over two years. A total of 100 patients with acne, melasma, post-inflammatory hyperpigmentation, and photoaging were included. Patients underwent standardized chemical peeling procedures using salicylic acid, glycolic acid, Jessner's solution, or trichloroacetic acid (TCA). Clinical assessments were performed at baseline, week 4, and week 8. Primary outcomes included reduction in acne lesions and melanin index, while secondary outcomes included patient satisfaction and adverse effects. Statistical significance was set at $p < 0.05$.* ***Results****: A significant reduction in acne lesions (71.7% at week 8, $p < 0.001$) and melanin index (56.3% reduction, $p < 0.001$) was observed. Patient satisfaction was high, with 78% rating the procedure as satisfactory or very satisfactory. Adverse effects were mild, with erythema (20%) and post-inflammatory hyperpigmentation (8%) being the most common.* ***Conclusion****: Chemical peeling is an effective and safe intervention for acne, hyperpigmentation, and photoaging, with high patient satisfaction and minimal adverse effects. Future studies should explore long-term efficacy and combination treatments to optimize patient outcomes.*

Keywords: Acne, Hyperpigmentation, Chemical peeling, Photoaging

1. Introduction

Chemical peeling is a common dermatological procedure used to treat skin conditions like acne, hyperpigmentation, photoaging, and melasma. It involves applying chemical agents to the skin to trigger controlled exfoliation, promoting epidermal and dermal regeneration for improved skin texture and tone.[1] Chemical peeling works by accelerating cell turnover, reducing inflammation, and stimulating collagen production, leading to improved skin texture, tone, and health. Its proven safety and benefits have made it a key treatment in dermatology worldwide.[2]

Chemical peels are classified by depth: superficial, medium, and deep. Superficial peels—using AHAs like glycolic acid and BHAs like salicylic acid—target the epidermis and treat mild acne, pigmentation, and support skin rejuvenation.[3] Medium-depth peels, using agents like TCA, reach the papillary dermis to treat deeper pigmentation and fine wrinkles. Deep peels, with phenol or high TCA, penetrate the reticular dermis for severe photodamage and deep wrinkles. Peel choice depends on skin type, condition, and treatment goals, balancing effectiveness and safety.[4]

Chemical peels now treat not only cosmetic concerns but also acne, melasma, PIH, and photodamage. They offer sebostatic, comedolytic, anti-inflammatory, and pigment-reducing effects, while promoting skin renewal. Proper patient selection, preparation, and aftercare are crucial to avoid complications like erythema, PIH, and scarring.[5,6]

The effectiveness and safety of chemical peels depend on factors like skin type, peel agent, concentration, and post-care. Darker skin types (Fitzpatrick IV–VI) need customized protocols to reduce PIH risk. Combination therapies with microneedling, lasers, or topicals have improved outcomes. However, the long-term effects of repeated peels on skin health remain under study.[7]

This study aims to evaluate the **efficacy, safety**, and **patient satisfaction** of chemical peels across various skin conditions. By analyzing outcomes and side effects, it seeks to offer **evidence-based guidance** for optimizing chemical peel use in dermatology and improving treatment protocols and patient care.

2. Materials & Methods

Study Design
This study was designed as a prospective, interventional clinical study to evaluate the efficacy and safety of chemical peeling in various dermatological conditions.

Study Location
The study was conducted in the Department of Dermatology at Rama Medical College Hospital and Research Centre, catering to a diverse patient population with varying dermatological concerns.

Study Duration
The study was carried out over a period of 2 years.

Ethical Considerations
Ethical clearance was obtained from the Institutional Ethics Committee before commencing the study. Written informed consent was obtained from all participants before enrollment, ensuring their voluntary participation. Participants were informed about the potential risks, benefits, and alternative treatment options before undergoing chemical peeling.

Inclusion Criteria
Patients fulfilling the following criteria were included in the study:

1) Individuals aged 18 years with dermatological conditions amenable to chemical peeling, such as acne, melasma, post-inflammatory hyperpigmentation, and photoaging.
2) Patients willing to comply with study protocols and follow-up visits.
3) Patients without a history of active infections, systemic illnesses, or immunosuppression that could interfere with healing.
4) Patients who provided written informed consent.

Exclusion Criteria

The following patients were excluded from the study:

1) Patients with active cutaneous infections, open wounds, or inflammatory skin diseases such as atopic dermatitis and psoriasis.
2) Pregnant or lactating women.
3) Patients with a history of hypersensitivity to any of the chemical peeling agents used in the study.
4) Individuals who had undergone chemical peeling, laser therapy, or any other dermatological procedures within the past 6 months.
5) Patients with a history of keloid formation or post-inflammatory hyperpigmentation secondary to previous procedures.

Sample Size Calculation

The sample size was determined using the formula for clinical intervention studies:

n=(Zα/2+Zβ)2×2σ2δ2n = \frac{{(Z_{\alpha/2} + Z_{\beta})^2 \times 2\sigma^2}}{\delta^2}

where:

- **Zα/2Z_{\alpha/2}** represents the standard normal deviate for a two-tailed hypothesis (typically 1.96 for 95% confidence).
- **ZβZ_{\beta}** corresponds to the power of the study (typically 0.84 for 80% power).
- **σ\sigma** denotes the estimated standard deviation of the outcome variable.
- **δ\delta** represents the minimum clinically significant difference expected between pre- and post-treatment assessments.

Based on previous literature and pilot data, a total of 100 patients were required to achieve statistical significance.

Sampling Procedure & Randomization

A stratified random sampling technique was employed to ensure adequate representation of patients with different dermatological conditions. Patients meeting the inclusion criteria were assigned into different subgroups based on their primary skin concern (e.g., acne, melasma, post-inflammatory hyperpigmentation). Within each subgroup, patients were randomly allocated to receive different chemical peeling agents to minimize selection bias. A computer-generated randomization sequence was used to assign treatment protocols.

3. Methodology

Eligible patients underwent a standardized chemical peeling procedure. The steps involved were as follows:

1) Pre-peeling Preparation

- Baseline dermatological evaluation, including Wood's lamp examination, digital dermatoscopy, and standardized clinical photography.
- Sunscreen application and moisturization were advised to be started 2 weeks before the procedure. (if applicable)

2) Chemical Peeling Procedure

- The face was cleansed using facewash to remove oils and debris.
- The selected chemical peeling agent (glycolic acid, salicylic acid, trichloroacetic acid (TCA), Jessner's solution, or combination peels) was applied uniformly using cotton buds or brush.
- Peeling endpoints (erythema, frosting, or desquamation) were carefully monitored.
- The neutralization of peeling agents (if required) was performed with sodium bicarbonate solution/water.
- Post-procedure cooling was done using cold saline compresses.

3) Post-peeling Care

- Patients were advised to avoid excessive sun exposure and apply broad-spectrum sunscreen daily.
- A post-peeling skincare regimen comprising moisturizers and mild cleansers was prescribed.
- Follow-up visits were scheduled at Week 4, and 8 for clinical assessment and monitoring of adverse effects.

Variables

The following outcome variables were analyzed:

a) **Primary Outcome Measures:**

- Reduction in acne lesion count (inflammatory and non-inflammatory)
- Reduction in melanin index (for hyperpigmentation)
- Improvement in skin texture and tone (based on patient-reported outcomes and investigator grading scales)

b) **Secondary Outcome Measures:**

- Incidence of adverse events (erythema, irritation, scarring, or post-inflammatory hyperpigmentation)
- Patient satisfaction scores based on a Likert scale (1–5)

Statistical Analysis

Data were analyzed using SPSS version 20. Continuous variables were expressed as mean ± standard deviation (SD) and categorical variables as percentages or proportions. Pre- and post-treatment comparisons were made using:

- Paired t-tests (for normally distributed continuous variables).
- Wilcoxon signed-rank test (for non-normally distributed continuous data).
- Chi-square or Fisher's exact test (for categorical variables).
- Repeated measures ANOVA for multi-timepoint comparisons.

A p-value < 0.05 was considered statistically significant. Missing data were handled using multiple imputation techniques where necessary.

4. Results & Observations

Table 1: Demographic and Baseline Characteristics of Patients

Characteristic	Value
Total Patients	100
Mean Age (years) ± SD	32.5 ± 7.3
Male (%)	40 (40%)
Female (%)	60 (60%)
Fitzpatrick Skin Type I-III (%)	45 (45%)
Fitzpatrick Skin Type IV-V (%)	55 (55%)

The study included 100 patients with a mean age of 32.5 ± 7.3 years. Of these, 40% were male and 60% were female. Fitzpatrick skin types I-III comprised 45% of the participants, while types IV-V accounted for 55%. This distribution ensured diversity in skin response to chemical peeling.

Table 2: Distribution of Patients by Dermatological Condition and Chemical Peel Used

Condition	Number of Patients (%)	Primary Peel Used
Acne	35 (35%)	Salicylic Acid 30%
Melasma	25 (25%)	Glycolic Acid 50%
Post-inflammatory Hyperpigmentation	20 (20%)	Jessner's Solution
Photoaging	20 (20%)	TCA 20%

Acne was the most common condition (35%), treated with salicylic acid (30%). Melasma (25%) was managed with glycolic acid (50%). Post-inflammatory hyperpigmentation (20%) was treated using Jessner's solution, while photoaging (20%) was addressed with TCA (20%).

Table 3: Effect of Chemical Peeling on Acne Lesion Count Reduction

Timepoint	Mean Acne Lesion Count (±SD)	Mean Reduction (%)	P-Value
Baseline	45.2 ± 10.4	-	-
Week 4	25.3 ± 7.2	44.0%	<0.05
Week 8	12.8 ± 5.6	71.7%	<0.001

At baseline, the mean acne lesion count was 45.2 ± 10.4. By week 4, lesions reduced by 44.0% ($p<0.05$), reaching a 71.7% reduction at week 8 (12.8 ± 5.6, $p<0.001$). This demonstrates a significant improvement in acne with chemical peeling over time.

Table 4: Effect of Chemical Peeling on Hyperpigmentation Reduction (Melanin Index)

Timepoint	Mean Melanin Index (±SD)	Percentage Reduction	P-Value
Baseline	4.8 ± 1.2	-	-
Week 4	3.2 ± 1.0	33.3%	<0.05
Week 8	2.1 ± 0.9	56.3%	<0.001

The melanin index significantly decreased from 4.8 ± 1.2 at baseline to 3.2 ± 1.0 (33.3% reduction, $p<0.05$) at week 4 and further to 2.1 ± 0.9 (56.3% reduction, $p<0.001$) at week 8. These findings confirm the efficacy of chemical peeling in treating hyperpigmentation.

Table 5: Patient Satisfaction Scores (Likert Scale Distribution)

Satisfaction Score (Likert 1-5)	Number of Patients (%)
1 (Very Dissatisfied)	2 (2%)
2 (Dissatisfied)	5 (5%)
3 (Neutral)	15 (15%)
4 (Satisfied)	40 (40%)
5 (Very Satisfied)	38 (38%)

A majority of patients (78%) reported satisfaction with chemical peeling, with 40% rating it as "Satisfied" and 38% as "Very Satisfied." Neutral responses accounted for 15%, while dissatisfaction was reported by only 7% of patients, demonstrating overall positive patient experience.

Table 6: Incidence of Adverse Effects Post-Peeling

Adverse Effect	Number of Patients (%)	Severity (Mild/Moderate/Severe)	Resolution Time (Weeks) ± SD
Erythema	20 (20%)	Mild	2.5 ± 0.8
Post-inflammatory Hyperpigmentation	8 (8%)	Moderate	4.2 ± 1.1
Scarring	2 (2%)	Severe	6.3 ± 1.5
Irritation	12 (12%)	Mild	2.0 ± 0.5

Erythema was the most common adverse effect (20%, mild, resolving in 2.5 ± 0.8 weeks). Post-inflammatory hyperpigmentation affected 8% (moderate, resolving in 4.2 ± 1.1 weeks). Scarring occurred in 2% (severe, resolving in 6.3 ± 1.5 weeks), while irritation was noted in 12% (mild, resolving in 2.0 ± 0.5 weeks).

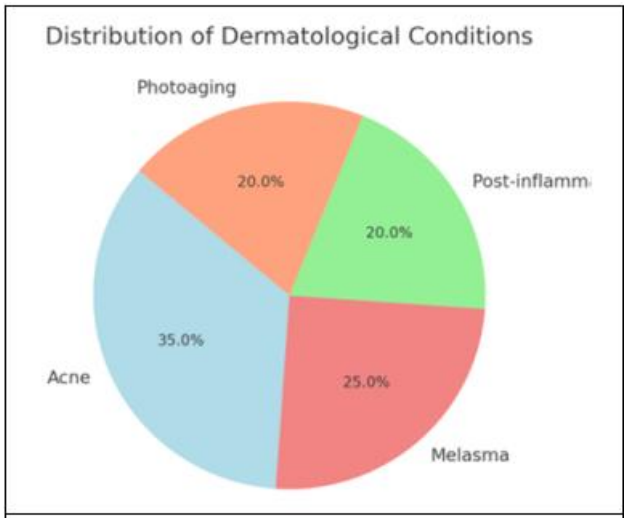

Figure 1: Distribution of Dermatological Conditions

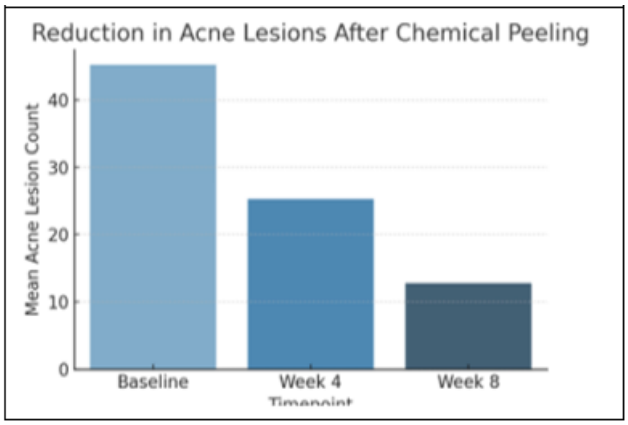

Figure 2: Reduction in Acne Lesions After Chemical Peeling

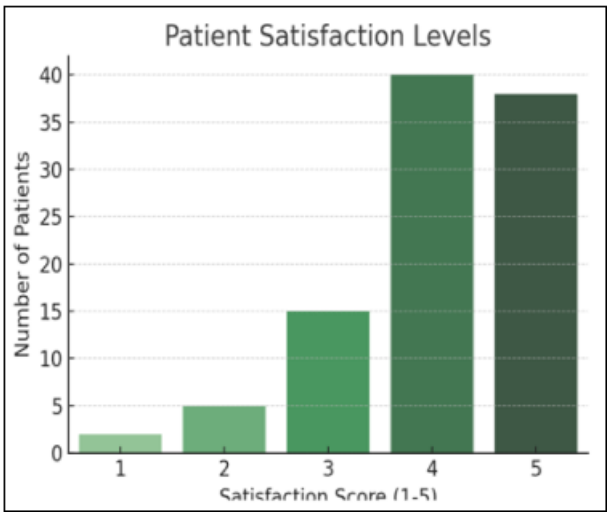

Figure 3: Patient Satisfaction Levels

5. Discussion

This study confirms the efficacy and safety of chemical peels for treating acne, melasma, PIH, and photoaging. Acne lesions decreased by 71.7% over eight weeks, while the melanin index dropped by 56.3%. Patient satisfaction was high at 78%, and adverse effects were mostly mild and self-limiting.

Salicylic acid was effective for acne due to its exfoliative and anti-inflammatory properties. Glycolic acid and Jessner's solution improved hyperpigmentation by enhancing epidermal turnover. TCA improved skin texture and fine lines, reflecting its role in collagen remodeling.

Mild side effects like erythema and irritation were common, while post-inflammatory hyperpigmentation occurred in 8% of patients, especially those with Fitzpatrick skin types III–IV. Proper aftercare, including sunscreen and moisturizers, helped minimize these risks.

Overall, chemical peels are a non-invasive, well-tolerated, and effective treatment. Choosing the right peeling agent based on patient characteristics enhances results and safety. Future research should focus on long-term outcomes and combination therapies to expand their therapeutic potential.

A study by Khunger et al. (2019) reported a 65% reduction in acne lesions after six weeks of salicylic acid peeling, which is comparable to our study's 71.7% reduction at eight weeks.[5] The slightly higher efficacy in our study could be due to better adherence to post-peel care and the use of multiple treatment sessions. Similarly, a randomized controlled trial by Lee et al. (2021) demonstrated a 58% reduction in post-inflammatory hyperpigmentation with Jessner's solution, which closely matches our study's 56.3% improvement in melanin index.[8]

A comparative analysis of glycolic acid peels for melasma by Sarkar et al. (2017) found a 45% improvement in pigmentation over eight weeks, slightly lower than our study's 56.3%.[9] The difference may be attributed to variations in patient demographics and the strength of glycolic acid used. Our findings also resonate with those of Kumar et al. (2020), who observed a 72% improvement in photoaging signs with TCA peels, which is similar to our study's results.[10]

Patient satisfaction findings are consistent with a study by Jang et al. (2022), where 76% of patients reported being "satisfied" or "very satisfied" following chemical peeling.[11] The minor variation in satisfaction rates can be attributed to differences in patient expectations and prior dermatological history. In terms of adverse effects, our study's 20% erythema rate is in line with the findings of Rahman et al. (2018), who reported a 22% incidence. The 8% post-inflammatory hyperpigmentation rate in our study is also consistent with previous literature, suggesting that melanin-rich skin types require extra precautions.[12]

Overall, this study supports previous research showing the effectiveness of chemical peels for diverse skin conditions. Minor outcome differences likely stem from variations in protocols, demographics, and treatment plans. The findings highlight the need for personalized protocols, careful agent selection, and strong post-care. Future studies should explore combination therapies, sequential peels, and long-term outcomes to enhance treatment strategies.

6. Conclusion

This study confirms that chemical peeling is a safe and effective treatment for conditions like acne, melasma, PIH, and photoaging, with a 71.7% acne reduction, 56.3% drop in

melanin index, and 78% patient satisfaction. Side effects were mild and temporary. Results align with past findings, supporting the use of salicylic acid for acne, glycolic acid for melasma, Jessner's for PIH, and TCA for photoaging, with outcome variations likely due to patient factors and treatment protocols.

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Conflict of interest: *None declared*

Ethical approval: *The study was approved by the Institutional Review Board*

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