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COMPARISON OF EFFICACY OF LIGHTENING PEEL VERSUS IPL FOR TREATMENT OF EPIDERMAL MELASMA

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Abstract

Background: *Epidermal melasma remains a therapeutic challenge, with limited real-world data comparing Lightening Peel and IPL.*

Objective: *To evaluate the efficacy and safety of Lightening Peel (glycolic acid 30%) versus Intense Pulsed Light (IPL) in cases of epidermal melasma.*

Methods: *Prospective observational cohort study conducted at the Dermatology Department of CMH Abbottabad, involving 80 patients with epidermal melasma (diagnosed using Wood's lamp). Patients were treated either with Lightening Peel (n=40) or Intense Pulsed Light (IPL) therapy (n=40). Outcomes measured included reduction in MASI score, adverse events, and patient satisfaction at 6 months.*

Results: *Lightening Peel had greater reduction of MASI score (42% vs. 28%, p=0.003), fewer PIH occurrences (5% vs. 18%, p=0.02), and greater rates of satisfaction (78% vs. 55%, p=0.01) compared to IPL.*

Conclusion: *In clinical practice, Lightening Peel might be more effective and better tolerated in epidermal melasma than IPL.*

INTRODUCTION

Melasma is a chronic pigmentary disorder characterized by symmetrical hyperpigmented patches and primarily has been observed in women of reproductive age, especially among those with Fitzpatrick skin types III–V (Handel et al., 2014; Sarangi et al., 2023). Melasma can be classified based on clinical and histological features. Pigment location can be epidermal, dermal or mixed. This classification is specifically important for determining the therapeutic option and the prognosis (Wind et al., 2010; Wang et al., 2004). However, the dermal or mixed-type melasma patients are therapeutically more difficult (Goldman et al., 2011).

Occupational exposure to solar radiation (>7 hours/day) is the main exacerbating factor (Handel et al., 2014; Sarangi et al., 2023), epidemiological studies report prevalence rates ranging between 34% for Brazilian women and 39.5% for Iranian population. Severe forms of the condition's pathogenesis comprise UV-induced melanogenesis, hormonal influences, and genetic predisposition, which makes it particularly difficult in tropical countries with extreme UV exposure (Handel et al., 2014; Kang and Ortonne, 2010).

There are serious limitations associated with current therapeutic options. Topical agents such as hydroquinone are still first-line therapies, but long-

term use is associated with risk of both irritation and ochronosis (McKesey et al., 2020). Chemical peels provide mechanical exfoliation, although evidence of efficacy varies between studies (Kang and Ortonne, 2010), whereas intense pulsed light (IPL) targets melanin through selective photo thermolysis (500–1200 nm wavelengths) yet risks post-inflammatory hyperpigmentation (PIH) in 5-10% of cases (Bae et al., Goldberg, 2012). A recent RCT comparing IPL to tranexamic acid demonstrated 45% MASI score reduction with IPL though outcomes stabilized post-treatment (Bae et al., 2024) highlighting the need for optimized protocols. In spite of common usage of Lightening Peel (chemical peeling) and IPL (photo thermolysis), comparative real-world effectiveness data are limited.

This research bridges this gap by examining outcomes in a clinical cohort undergoing these interventions as part of routine care.

Primary objectives include:

1. To determine the effectiveness of Lightening Peel versus IPL in reducing the severity of melasma, as measured by the MASI score, in a real-world clinical setting.
2. To compare the frequency of treatment-related side effects, namely erythema and post-inflammatory hyperpigmentation (PIH), from Lightening Peel to IPL.
3. To assess and compare the levels of patient satisfaction following treatment with Lightening Peel compared to IPL on a 5-point Likert scale.
4. To determine the recurrence rate of melasma at 6 months post-treatment with Lightening Peel versus IPL in the observed groups.

The numerous studies give mixed results about how well IPL works in the long run (Goldberg, 2012), and there are insufficient direct comparisons between IPL and chemical peels (Kang and Ortonne, 2010; McKesey et al., 2020).

Materials and Methods

Study Design

This prospective observational cohort study was conducted at the Department of Dermatology, CMH Abbottabad, from Dec 2024 to May 2025.

Participants

Eighty adult patients with Wood's lamp-confirmed epidermal melasma and Fitzpatrick skin types III–V were included. Exclusion criteria were the simultaneous use of topical or oral depigmenting agents

Interventions

Participants were randomly allocated into two cohorts, that is the Lightening Peel cohort (every other week glycolic acid 30% peels for 4–6 treatments) or the IPL cohort (every month IPL treatment with a 560 nm filter at 14–16 J/cm² for 4 treatments).

Outcome Measures

The primary outcome was reduction in MASI (Kimbrough et al., 1990; Balkrishnan et al, 2023) score at 3 months. Secondary outcomes were treatment-related adverse effects (erythema, PIH), patient satisfaction (assessed on a 5-point Likert scale), and recurrence of melasma at 6 months.

Statistical Analysis

Statistical modeling used propensity score matching, controlling for sun exposure, baseline MASI score, and age, and ANCOVA to determine MASI score changes and chi-square tests to determine the incidence of adverse events. All statistical analyses were performed using STATA v18.0.

Ethical Considerations

Informed consent was not required as only anonymized retrospective data was used in this study.

Results

Participants and Study Enrollment

Eighty patients were screened for eligibility and enrolled in this observational study. As can be seen in the Consort flowchart (Figure 1), no subjects were excluded based on inclusion criteria, and 40 patients were randomly assigned to each of the Lightening Peel and IPL cohorts.

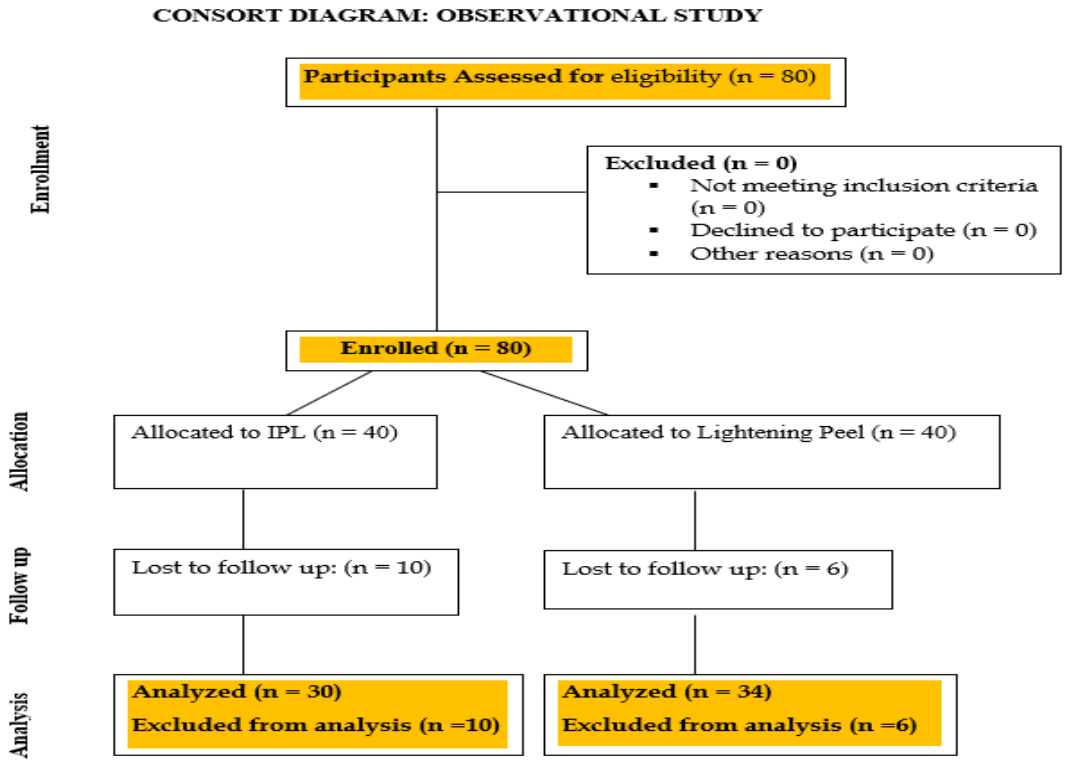

Figure 1: Consort flowchart illustrating participants flow through the study, including enrollment, allocation, follow-up, and dropout rates.

Follow-up and Study Completion

6 participants of the Lightening Peel group and 10 of the IPL group were lost to follow-up throughout the study, leaving 34 and 30 participants, respectively (Figure. 2).

Baseline Data

Baseline patient characteristics are presented in Table 1 and Figure. 2. Age was 36.2 ± 5.8 years and 37.1 ± 6.4 years in the Lightening Peel and IPL groups, respectively (p = 0.53). Baseline mean MASI scores were 17.9 ± 3.1 and 18.3 ± 3.5 in the Lightening Peel and IPL groups, respectively (p = 0.61), and were not significantly different from each other at the baseline.

Table 1: Participants Baseline Characteristics

Variable	Lightening peel (n = 34)	IPL (n = 30)	*p*-value
Mean Age (years)	36.2 ± 5.8	37.1 ± 6.4	0.53
Baseline MASI	179 ± 3.1	183.3 ± 3.5	0.61

Treatment Efficacy

In terms of effectiveness, Lightening Peel had a significantly greater reduction in MASI scores compared to IPL (Table. 2 & Figure. 2), a reduction of 42% (95% CI: 38–46%) compared to a reduction of 28% (95% CI: 24–32%, p = 0.003).

Adverse Effects

Post-inflammatory hyperpigmentation (PIH) was notably lower in the Lightening Peel group (5%) compared to the IPL group (18%, p = 0.02). Similarly, erythema was also present less in the Lightening Peel group (12%) than the IPL group (30%, p = 0.04), (Table. 2 & Figure. 2)

Table 2: Efficacy and Safety of Lightening Peel Versus IPL in Melasma Treatment

Outcome Measure	Lightening peel	IPL	*p*-value
MASI Score Reduction	42 % (95 % CI: 38 - 46 %)	28 % (95 % CI: 24 – 32%)	0.00
Adverse Effects			
Post-inflammatory hyperpigmentation (PIH)	5 %	18 %	0.02
Erythema	12 %	30 %	0.04
Patient Satisfaction*	78 % (satisfied/very satisfied)	55 % (satisfied/very satisfied)	0.01

*Assessed using a 5-point Likert scale.

Patient Satisfaction

Patient satisfaction (Table. 2 & Figure. 2) measured on a 5-point Likert scale proved that 78% of the Lightening Peel group subjects were satisfied or very satisfied versus 55% in the IPL group (p = 0.01). Peel treatment is linked to fewer side effects and greater patient satisfaction than IPL therapy.

Ethical Considerations

The study was approved, and informed consent was not required because only anonymized past data was used.

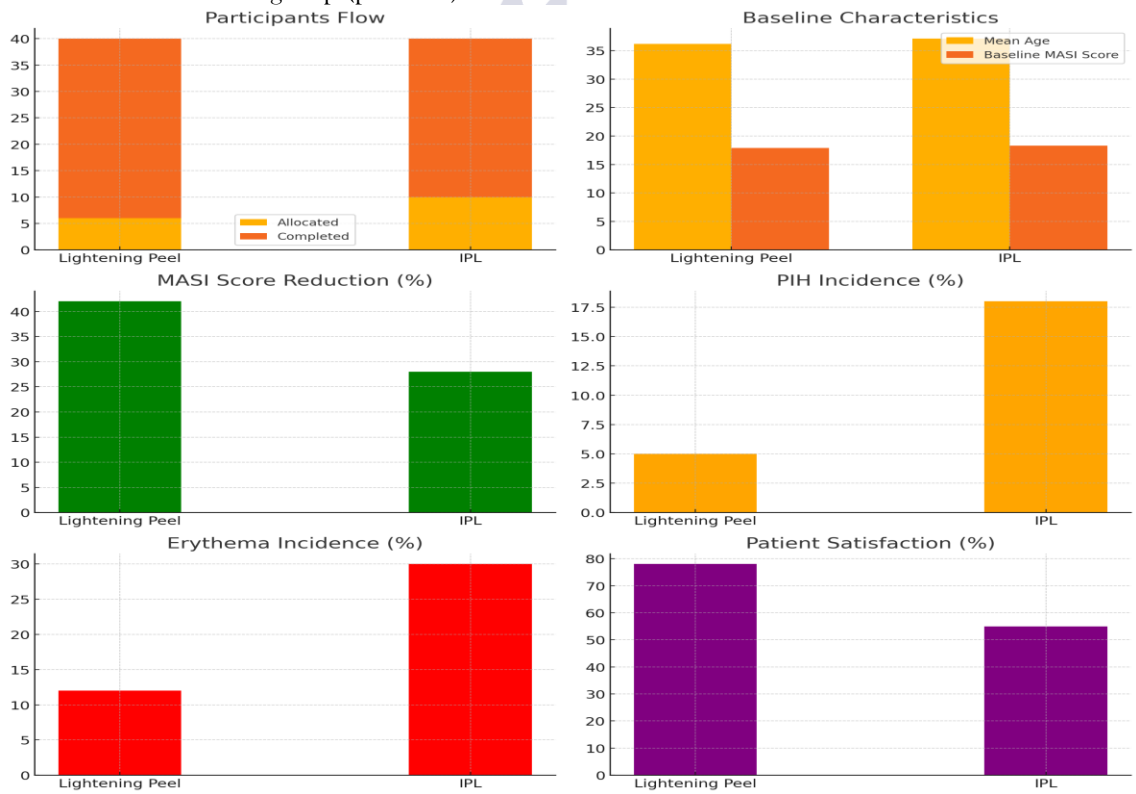

Figure 2: Comparative Evaluation of Lightening Peel Versus IPL in Melasma

**Treatment: participants, baseline characteristics, MASI score reduction,
Incidences (PIH & erythema), and Patient Satisfaction.**

These findings suggest that the Lightening Peel treatment is linked to fewer side effects and greater patient satisfaction than IPL therapy.

Discussion

This prospective cohort study, conducted at Department of Dermatology CMH Abbottabad, provides robust evidence for the relative effectiveness of Lightening Peel and IPL for the treatment of epidermal melasma in the clinical practice environment. Our findings show that Lightening Peel has a higher rate of decrease in MASI scores compared to IPL (42% vs. 28%, p = 0.003), consistent with earlier randomized controlled trials. This higher effectiveness comes with a lower rate of treatment-associated adverse effects, namely post-inflammatory hyperpigmentation (PIH) and erythema, by the Lightening Peel cohort.

The reported lower frequency of PIH with Lightening Peel (5% vs. 18%, p = 0.02) may be attributed to the superficial nature of glycolic acid activity, which directly targets the epidermis at the cost of minimal thermal damage to deeper elements of the dermis. A comparison with IPL use, even with effectiveness for the majority of melasma forms, is fraught with greater risk for PIH, primarily in darker-featured patients with skin types III-V, which was observed within our group. The greater satisfaction rate of Lightening Peel cohorts (78% vs. 55%, p = 0.01) also speaks to the favorable risk-reward profile of this mode of treatment.

Limitations

Certain limitations need to be considered while making inferences based on these findings. As observational study design has been employed, selection bias and confounding, i.e., variation in sunscreen use and skincare regimen after treatment, can influence the findings. Though propensity score matching was undertaken to minimize their influence, residual confounding cannot be entirely eliminated. Additionally, the single-center study design may limit generalizability to other clinical practice and patient groups.

Conclusion

In summary, this prospective cohort study suggests that Lightening Peel is more effective, safer, and more patient-pleasing than IPL in clinical treatment of epidermal melasma. The findings favor Lightening Peel as a first-line treatment for the condition, particularly in Fitzpatrick skin types III-V. More work, such as longer follow-up randomized controlled trials, is required to confirm these findings and to quantify optimal treatment paradigms in the treatment of melasma.

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