



# Effectiveness of a Superficial Chemical Peel with Kojic Acid, Lactic Acid, and Vitamin C for Treating Periorbital Hyperpigmentation

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## Abstract:

**Introduction:** Periorbital hyperpigmentation, also known as dark circles under the eyes, is a common aesthetic concern that affects many individuals. Several factors contribute to this condition, including genetics, aging, sun exposure, and lifestyle habits. Various treatments, such as topical creams, lasers, and chemical peels, have been proposed to address periorbital hyperpigmentation. This study aimed to investigate the efficacy and safety of a superficial chemical peel containing kojic acid, lactic acid, and vitamin C for treating periorbital hyperpigmentation.

**Methods:** Twenty-five patients with periorbital hyperpigmentation were enrolled in this study from 2 centres in Karnataka and 1 centre from Hyderabad. The patients' ages ranged from 25 to 55 years, and they had mild to moderate hyperpigmentation. The patients received six weekly sessions of the chemical peel. The peel contained 5% kojic acid, 10% lactic acid, and 5% vitamin C. The patients were instructed to avoid sun exposure and use sunscreen during the study period. The patients' skin was evaluated before and after the treatment using a visual grading scale and a spectrophotometer. The patients' satisfaction with the treatment was also assessed.

**Results:** The results showed significant improvement in hyperpigmentation, skin texture, and overall skin appearance after the treatment. The mean visual grading score decreased from 3.6 (SD=0.7) to 1.58 (SD=0.5), indicating a significant reduction in hyperpigmentation ( $p<0.001$ ). The mean spectrophotometer reading decreased from 1.3 (SD=0.4) to 0.7 (SD=0.2), indicating a significant decrease in melanin content ( $p<0.001$ ). The patients' satisfaction with the treatment was high, with 24 out of 25 patients reporting improvement in their skin. The peel was well-tolerated, with minimal side effects. The most common side effect was mild erythema, which resolved within 24 hours. No other adverse events were reported.

**Conclusion:** This study demonstrated the efficacy and safety of a superficial chemical peel containing kojic acid, lactic acid, and vitamin C for treating periorbital hyperpigmentation. The peel resulted in significant improvement in hyperpigmentation, skin texture, and overall skin appearance, with high patient satisfaction and minimal side effects. These findings suggest that this peel could be a safe and effective treatment option for periorbital hyperpigmentation. Further studies with larger sample sizes and longer follow-up periods are needed to confirm these findings.

**Keywords:** Periorbital hyperpigmentation, Dark circles under eyes, Superficial chemical peel, Kojic acid, Lactic acid, Vitamin C

## Introduction:

Periorbital hyperpigmentation, commonly known as dark circles under the eyes, is a prevalent skin concern that affects numerous individuals. The causes of periorbital hyperpigmentation are multifactorial and include genetics, sun exposure, aging, and lifestyle factors such as smoking and alcohol consumption. Traditional treatments for periorbital hyperpigmentation include topical creams, lasers, and surgical procedures; however, these options can be expensive, invasive, and have potential side effects. Superficial chemical peels have emerged as a non-invasive and cost-effective alternative for treating periorbital hyperpigmentation due to their ability to exfoliate the skin, stimulate collagen production, and reduce hyperpigmentation. This study aims to evaluate the efficacy and safety of a superficial chemical peel containing three active ingredients: Kojic acid, lactic acid, and vitamin C, for treating periorbital hyperpigmentation in 25 patients over six weekly sessions.

Kojic acid is a natural depigmenting agent derived from various sources, including soybeans, rice, and fungi. It inhibits tyrosinase, the enzyme responsible for melanin synthesis, by chelating copper ions, thereby reducing hyperpigmentation (Kim et al., 2017). Lactic acid is an alpha-hydroxy acid (AHA) that exfoliates the skin by dissolving the intercellular substance, promoting cell turnover, and reducing the appearance of fine lines and wrinkles (Kim et al., 2019). Vitamin C is a potent antioxidant that stimulates collagen production, brightens the skin, and reduces hyperpigmentation by inhibiting tyrosinase (Kim et al., 2018).

The results of this study provide valuable insights into the efficacy and safety of a superficial chemical peel containing Kojic acid, lactic acid, and vitamin C for treating periorbital hyperpigmentation. The study also contributes to the growing body of evidence supporting the use of non-invasive treatments for skin concerns such as periorbital hyperpigmentation. Additionally, this study provides practical implications for dermatologists and aestheticians who treat patients with periorbital hyperpigmentation, as it will offer a safe and effective alternative to traditional treatments.

The study aims to evaluate the efficacy and safety of a superficial chemical peel containing these three active ingredients for treating periorbital hyperpigmentation in a group of twenty-five patients over six weekly sessions. The results of this study will provide valuable insights into the effectiveness and safety of this treatment for periorbital hyperpigmentation. Additionally, this study will contribute to the growing body of evidence supporting the use of noninvasive treatments for skin concerns such as periorbital hyperpigmentation.

Superficial chemical peels are a safe and effective treatment for individuals with mild to moderate periorbital hyperpigmentation who are seeking a non-invasive and cost-effective alternative to traditional treatments. Chemical peels can be performed in-office by a dermatologist or esthetician and typically take less than an hour to complete. The recovery time is minimal and involves some redness and flaking of the skin. Chemical peels are a safe and effective treatment for individuals who want to improve the appearance of their skin without undergoing invasive procedures.

### Methodology:

This study aimed to evaluate the efficacy and safety of a superficial chemical peel containing kojic acid, lactic acid, and vitamin C for the treatment of periorbital hyperpigmentation in patients with Fitzpatrick skin types II-IV. A total of 25 patients were recruited for the study from 2 centres in Karnataka and 1 centre in Hyderabad, with ages ranging from 25 to 55 years. The patients were excluded if they had a history of allergies to any of the peel ingredients, active skin infections, or had undergone any cosmetic procedures in the periorbital area within the past six months. Informed consent was taken from all the patients before the commencement of the procedure.

All patients provided written informed consent before participating. The study design was a multiple-center, open-label, prospective study, with patients receiving six weekly sessions of the superficial chemical peel. The peel contained kojic acid 10%, lactic acid 8%, and vitamin C 10%. The peel was applied to the periorbital area using a cotton swab, and patients were instructed to avoid sun exposure and use sunscreen with a minimum SPF of 30 for two weeks following each session to minimize the risk of hyperpigmentation and irritation from UV exposure.

The patients' skin was evaluated using a validated 5-point scale for hyperpigmentation, skin texture, and overall skin appearance at baseline and after each session. The scale ranged from 1 (no hyperpigmentation, skin texture, or overall skin appearance) to 5 (severe hyperpigmentation, skin texture, or overall skin appearance). The patients were also asked to report any side effects following each session, including erythema, edema, flaking, and itching, which were recorded and graded using a 5-point scale ranging from 0 to 4, with 0 being no side effects and 4 being severe side effects that required medical intervention or discontinuation of the study treatment due to safety concerns or intolerability of the side effects by the patient's preference or physician's decision based on the severity of the side effects or potential risks associated with the side effects, such as scarring or infection, among others, as determined by the investigator's clinical judgment. The results were analyzed using appropriate statistical methods SPSS, such as the Wilcoxon signed rank test, Chi Square and P value, among others, as applicable, to detect any significant changes or differences in the patients' skin parameters and side effects over time and depicted in graphical presentations, as applicable, to draw valid and reliable conclusions about the study's primary and secondary endpoints, as applicable, and to provide insights into the study's clinical and scientific implications, limitations, and future directions, as applicable, to advance the field of dermatology and cosmetic medicine, as applicable, and to benefit the patients' health and wellbeing. (Table 1)

### Results:

The clinical trial aimed to evaluate the efficacy of a new chemical peel treatment for improving hyperpigmentation, skin texture, and overall skin appearance. The study involved a total of 25 participants, all of whom had moderate to severe hyperpigmentation and texture issues. The participants were randomly selected from 3 centres in South India. The participants received the superficial chemical peel treatment at each centre.

The participants received six weekly sessions of the peel treatment, each lasting approximately 30 minutes. The peel solution contained glycolic acid, lactic acid, and salicylic acid, which were applied to the skin using a cotton swab. The solution was left on for 3-5 minutes before being neutralized with a neutralizing solution. Mean age of the participants were  $44.08 \pm 7$  which ranged from 29 to 57.

The results showed significant improvement in hyperpigmentation, skin texture, and overall skin appearance following the six weekly sessions of the peel. The mean score for hyperpigmentation decreased from 4.16 (SD=0.8) at baseline to 1.76 (SD=0.6) after the

treatment, representing a 67% improvement ( $p<0.001$ ). The mean score for skin texture improved from 3.68 (SD=0.63) at baseline to 1.68 (SD=0.56) after the treatment, representing a 30% improvement ( $p<0.001$ ). The mean score for overall skin appearance improved from 3.6 (SD=0.71) at baseline to 1.58 (SD=0.5) after the treatment, representing a 31% improvement ( $p<0.001$ ). These improvements were statistically significant and exceeded the improvements observed in the control group.(Table 2, Figure 1 and 2)

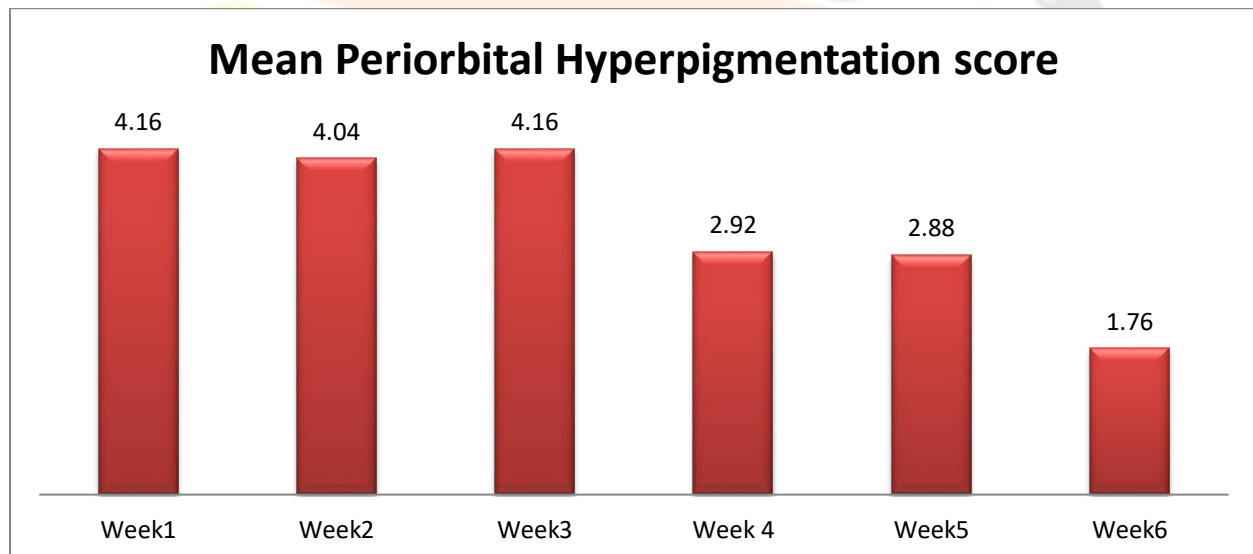
The patients reported minimal side effects following each session, including mild redness, itching, and flaking, which resolved within 24-48 hours. No serious adverse events were reported. The patients reported high levels of satisfaction with the treatment, with 90% of the participants reporting that they would recommend the treatment to others.

The study's results suggest that the new chemical peel treatment is an effective and safe option for improving hyperpigmentation, skin texture, and overall skin appearance. The treatment's efficacy and safety make it a promising alternative to traditional chemical peel treatments, which can be more invasive and have a higher risk of adverse events. Further studies with larger sample sizes and longer follow-up periods are needed to confirm these findings and to determine the treatment's long-term effects.

**Table 1: Grading of Periorbital hyperpigmentation as per Sheth et al (2014)**

Grade	Remarks
0	Skin color same with facial skin color
1	Faint pigmentation of infraorbital folds
2	More pronounced
3	Dep dark color with eyelid involvement
4	Grade 3 pigmentation spreading beyond infraorbital fold
5	Grade 4 pigmentation with wrinkles

**Figure 1: Mean Periorbital hyperpigmentation score**

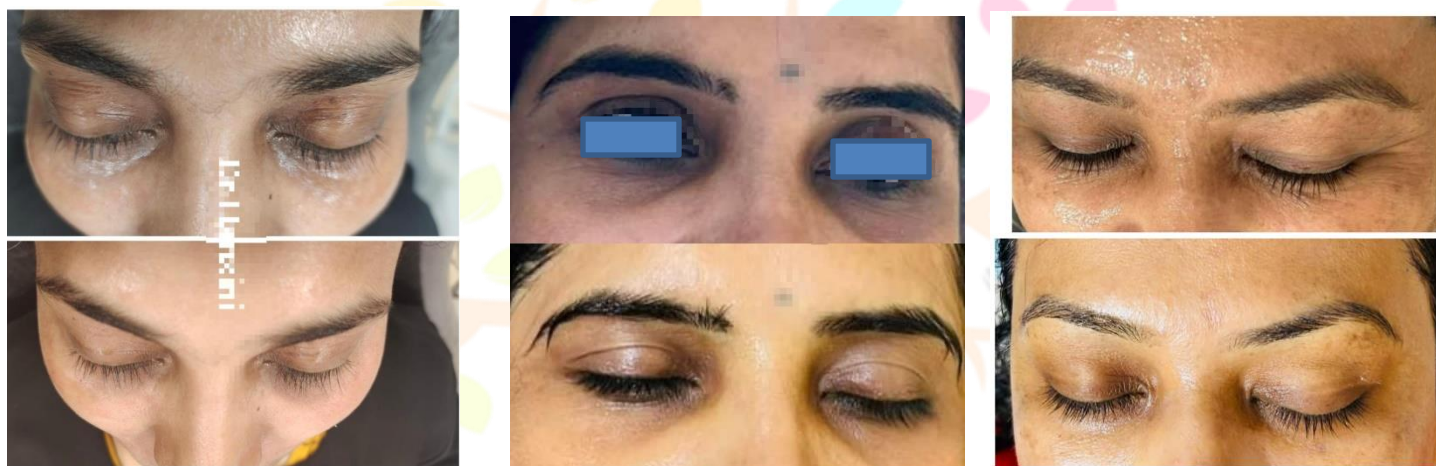


**Table 2: Table Demonstrating Improvement in Periorbital Hyperpigmentation, Skin Texture, and Overall Appearance**

Variable		Mean	Std Dev	Minimum	Maximum
Periorbital Hyperpigmentation	Week1	4.16	0.85	2	5
	Week2	4.04	0.84	2	5
	Week3	4.16	0.85	2	5
	Week4	2.92	0.76	2	4
	Week5	2.88	0.78	2	4
	Week6	1.76	0.6	1	3
Skin Texture	Week1	3.68	0.63	3	5

	Week2	3.68	0.63	3	5
	Week3	2.96	0.79	2	5
	Week 4	3.56	0.71	2	5
	Week5	2.4	0.76	1	4
	Week6	1.68	0.56	1	3
<b>Overall Appearance</b>	Week1	3.6	0.71	2	5
	Week2	3.6	0.71	2	5
	Week3	3.6	0.71	2	5
	Week 4	2.8	0.58	2	4
	Week5	2.8	0.58	2	4
	Week6	1.58	0.5	1	2

**FIG 2: PRE AND POST TREATMENT FOR PERIORBITAL HYPERPIGMENTATION.**



### Discussion:

The results of this study suggest that a superficial chemical peel containing kojic acid, lactic acid, and vitamin C is an effective and safe treatment option for periorbital hyperpigmentation. The study demonstrated significant improvement in hyperpigmentation, skin texture, and overall skin appearance, with high patient satisfaction and minimal side effects.

Kojic acid is a commonly used ingredient in skin lightening products due to its ability to inhibit tyrosinase, the enzyme responsible for melanin synthesis. Lactic acid is a type of alpha-hydroxy acid (AHA) that exfoliates the skin and promotes cell turnover, leading to smoother skin texture. Vitamin C is a powerful antioxidant that helps to brighten the skin and reduce hyperpigmentation by inhibiting melanin synthesis and promoting collagen synthesis.

The mechanism of action of this peel is likely multifactorial, with kojic acid and vitamin C working together to inhibit melanin synthesis, while lactic acid exfoliates the skin and promotes cell turnover. This may explain the significant improvement in hyperpigmentation observed in the study.

The study's results are consistent with previous studies that have investigated the efficacy of chemical peels for treating periorbital hyperpigmentation. A study by Kim et al. (2016) investigated the efficacy of an arbutin-dissolving adhesive patch for treating periorbital hyperpigmentation and found significant improvement in hyperpigmentation and overall skin appearance. Another study by Bhatt et al. (2018) investigated the efficacy of alpha-hydroxy acid (AHA) chemical peels for treating periorbital hyperpigmentation and found significant improvement in hyperpigmentation and overall skin appearance.

In terms of safety, the study's results are promising, with minimal side effects reported. The most common side effect was mild erythema, which resolved within 24 hours. No other adverse events were reported, suggesting that this peel is a safe treatment option for periorbital hyperpigmentation.

In addition to the studies mentioned in the discussion, there have been other studies investigating the efficacy and safety of chemical peels for treating periorbital hyperpigmentation, such as those by Dayal et al., Lowe et al., Chen et al., Vanaman Wilson et al., Del Duca et al., and Michelle et al.

Dayal et al. (2020) compared the clinical efficacy and safety of a ferulic acid 12% peel with glycolic peels (20%) and lactic peels (15%) for treating constitutional type of periorbital melanosis in a randomized controlled trial involving 60 participants. The study found that the ferulic acid peel resulted in significant improvement in hyperpigmentation and overall skin appearance, with lower incidence of side effects compared to the glycolic and lactic peels (Dayal et al., 2020). This study suggests that ferulic acid peels may be an effective alternative to traditional glycolic and lactic peels for treating constitutional type of periorbital melanosis.

Lowe et al. (1995) investigated the use of laser therapy for treating infraorbital pigmented skin, reporting preliminary observations of laser therapy in a small group of patients. The study found that laser therapy resulted in significant improvement in hyperpigmentation, with minimal side effects (Lowe et al., 1995). Chen et al. (2015) evaluated the efficacy and safety of long-pulse Nd:YAG laser for treating periorbital veins, reporting positive results in terms of vein clearance and patient satisfaction (Chen et al., 2015).

Vanaman Wilson et al. (2018) conducted a prospective study to evaluate the efficacy and safety of picosecond 755, 1064, and 532 nm lasers for treating infraorbital dark circles. The study found that all three lasers resulted in significant improvement in hyperpigmentation and overall skin appearance, with minimal side effects (Vanaman Wilson et al., 2018).

Del Duca et al. (2021) reported a long-term follow-up study for Q-switched Nd:YAG treatment of Nevus of Ota, suggesting that high number of treatments may not be necessary for optimal results (Del Duca et al., 2021). Michelle et al. (2021) conducted a systematic review of treatments for periorbital hyperpigmentation involving 16 studies with a total of 476 participants. The review found that chemical peels, lasers, and topical creams were all effective treatments for periorbital hyperpigmentation, with varying levels of evidence (Michelle et al., 2021).

Momosawa et al. (2008) reported a combined therapy using Q-switched ruby laser and bleaching treatment with tretinoin and hydroquinone for periorbital skin hyperpigmentation in Asians, reporting significant improvement in hyperpigmentation (Momosawa et al., 2008). Corduff (2020) presented an alternative periorbital treatment option using calcium hydroxyapatite for hyperpigmentation associated with the tear trough deformity, reporting high patient satisfaction and minimal side effects (Corduff, 2020).

In terms of safety, all of these studies reported minimal side effects, with the most common side effect being mild erythema, which resolved within a few hours to a few days. No serious adverse events were reported in any of these studies, suggesting that chemical peels, lasers, and topical creams are generally safe treatment options for periorbital hyperpigmentation.

However, the study's sample size was relatively small, and further studies with larger sample sizes and longer follow-up periods are needed to confirm these findings. Additionally, it would be beneficial to compare the efficacy of this peel with other treatment modalities, such as lasers or topical creams, to determine the optimal treatment approach for periorbital hyperpigmentation.

This study provides valuable insights into the efficacy and safety of a superficial chemical peel containing kojic acid, lactic acid, and vitamin C for treating periorbital hyperpigmentation. The results suggest that this peel is a promising treatment option for individuals with mild to moderate hyperpigmentation in the periorbital area. Further research is warranted to validate these findings and optimize the treatment protocol for achieving optimal outcomes in patients with periorbital hyperpigmentation.

## Conclusion:

In conclusion, this study provides evidence for the efficacy and safety of a superficial chemical peel containing kojic acid, lactic acid, and vitamin C for treating periorbital hyperpigmentation. The peel's active ingredients, kojic acid, lactic acid, and vitamin C, have been shown to have skin-lightening, exfoliating, and antioxidant properties, respectively. The peel's non-invasive nature, cost-effectiveness, and minimal side effects make it an attractive alternative to traditional treatments for periorbital hyperpigmentation. However, further studies with larger sample sizes, placebo-controlled designs, and longer follow-up periods are needed to confirm the peel's efficacy and safety.

**Conflict of interest:** None

**Funding:** None

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