

A COMPARATIVE STUDY FOR THE EFFICACY BETWEEN COMBINATION OF INTENSE PULSED LIGHT THERAPY AND 5% NIACINAMIDE CREAM WITH 5% NIACINAMIDE ALONE FOR THE TREATMENT OF AXILLARY HYPERPIGMENTATION

Nono KO¹ and Tanomkit PAWCSONTORN²

1,2 School of Anti-aging and Regenerative Medicine, Mae Fah Luang
University, Bangkok, Thailand; 6552001045@lamduan.mfu.ac.th (N. K.);
tanomkit@yahoo.com (T. P.)

ARTICLE HISTORY

Received: 8 May 2026

Revised: 11 May 2026

Published: 22 May 2026

ABSTRACT

Axillary hyperpigmentation (AH) is a common dermatological concern, particularly among individuals with darker skin types, and can negatively affect aesthetic appearance and quality of life. This study aimed to compare the efficacy of combination therapy using intense pulsed light (IPL) with 5% niacinamide cream versus 5% niacinamide monotherapy in the treatment of AH. A prospective, randomized, split-site study was conducted in 22 participants with bilateral AH. One axilla received IPL at weeks 0, 4, and 8 with daily niacinamide, while the other received niacinamide alone for 12 weeks. Outcomes were assessed using melanin index, clinical photography, Global Aesthetic Improvement Scale (GAIS), and patient satisfaction. The combination therapy showed significantly greater melanin reduction compared to monotherapy ($p < 0.05$). Higher improvement and satisfaction scores were also observed in the combination group. Both treatments were well tolerated with minimal adverse effects. Combination therapy with IPL and 5% niacinamide is more effective than niacinamide alone for treating axillary hyperpigmentation.

Keywords: Axillary Hyperpigmentation, Intense Pulsed Light (IPL), Niacinamide, Post-Inflammatory Hyperpigmentation (PIH), Melanin Index, Mexameter, Split-Site Study, Combination Therapy, Skin Pigmentation, Dermatologic Treatment

CITATION INFORMATION: Ko, N., & Pawcsontorn, T (2026). A Comparative Study for The Efficacy Between Combination of Intense Pulsed Light Therapy And 5% Niacinamide Cream With 5% Niacinamide Alone for The Treatment of Axillary Hyperpigmentation. *Procedia of Multidisciplinary Research*, 4(5), 17.

INTRODUCTION

Human Skin tone is primarily determined by melanin, and its overproduction can lead to hyperpigmentation (James et al., 2006). Axillary hyperpigmentation (AH) is a frequent cosmetic concern, particularly in darker skin types. It is commonly considered a form of post-inflammatory hyperpigmentation caused by repeated irritation of the axillary skin. (Amornpetkul et al., 2021a; James et al., 2006) The axilla is prone to irritation due to shaving, friction, and cosmetic use, which can disrupt the skin barrier and stimulate melanogenesis (James et al., 2006). Currently, there is no standardized treatment for axillary hyperpigmentation, and available evidence remains limited. Current treatment options include topical agents such as hydroquinone, retinoids, and niacinamide, which act by reducing melanogenesis or melanosome transfer. (Arora et al., 2012) (J. Y. Park et al., 2017) Niacinamide (nicotinamide), an active form of vitamin B3, has gained attention due to its ability to inhibit melanosome transfer and improve skin barrier function. (Boo, 2021) Clinical studies have demonstrated that topical niacinamide at concentrations of 2–5% can significantly improve hyperpigmented lesions in a dose-dependent manner. (A T S U B A R A, 2002) In addition to topical treatments, procedural approaches such as chemical peels, lasers, and light-based therapies are used to remove existing pigments. (Castanedo-Cazares et al., 2013b) Intense pulsed light (IPL) is a non-invasive light-based therapy that targets melanin and has demonstrated effectiveness in treating hyperpigmentation. (Amornpetkul et al., 2021b) Previous studies have reported significant improvement in post-inflammatory hyperpigmentation using IPL, with high efficacy and favorable safety profiles. (J. H. Park et al., 2016) However, evidence for AH remains limited. This study aims to compare the efficacy of IPL combined with 5% niacinamide versus niacinamide alone in treating axillary hyperpigmentation.

LITERATURE REVIEWS

Melanocytes are neural crest-derived cells located in the basal layer of the epidermis and hair follicles. Each melanocyte interacts with 30–40 keratinocytes, forming the epidermal melanin unit. (Cichorek et al., 2013) Melanin determines skin, hair, and eye color and protects against UV radiation. Melanogenesis begins when tyrosinase oxidizes tyrosine into dopaquinone, the rate-limiting step, leading to eumelanin or pheomelanin production depending on intracellular factors such as thiol availability (Land & Riley, 2000). Axillary hyperpigmentation (AH), commonly referred to as dark underarms, is a frequently cosmetic concern, particularly in darker skin types. (Amornpetkul et al., 2021a) It is typically considered a mild form of post-inflammatory hyperpigmentation, resulting from increased melanin production following repeated irritation or inflammation. (James et al., 2006) Contributing factors include frequent shaving, friction from tight clothing, use of deodorants, and mechanical stress. (Evans et al., 2012) These factors disrupt the skin barrier, leading to inflammation and melanocyte activation. Repeated shaving may cause epidermal thickening and inflammatory responses, further exacerbating pigmentation. (Evans et al., 2012). (Turner et al., 2006) Higher body mass index (BMI) and baseline skin tone are also associated with increased risk (Evans et al., 2012). (Gade et al., 2024) Management of axillary hyperpigmentation is challenging due to its multifactorial etiology, and no standardized treatment exists. (Amornpetkul et al., 2021c) (30) Treatment strategies generally target two main mechanisms: reduction of melanin production and removal of existing pigment. (Castanedo-Cazares et al., 2013a) Preventive approaches include minimizing irritation and restoring the skin barrier through moisturizers and gentle skincare practices. (Evans et al., 2012) Topical agents

remain the mainstay of treatment and act by inhibiting tyrosinase, suppressing melanocyte activity, or reducing melanosome transfer.(Nautiyal & Wairkar, 2021a). Procedural treatments include chemical peels and light-based therapies, which promote exfoliation and melanin clearance (Moolla & Miller-Monthrope, 2022)Laser and intense pulsed light (IPL) therapies target melanin through selective photo thermolysis, leading to pigment breakdown.(Nautiyal & Wairkar, 2021b)

Niacinamide

Niacinamide (vitamin B3) is a precursor of nicotinamide adenine dinucleotide (NAD+), essential for cellular metabolism and repair.(Bains et al., 2018)It exhibits multiple dermatological benefits, including anti-inflammatory, antimicrobial, antioxidant, and barrier-enhancing properties. (Wohlrab & Kreft, 2014) Niacinamide reduces pigmentation by inhibiting melanocyte–keratinocyte interaction and suppressing melanosome transfer.(Gehring, 2004)Clinical studies show that 2–5% topical formulations significantly improve hyperpigmentation, including axillary hyperpigmentation. (Castanedo-Cazares et al., 2013b)

Intense pulsed light (IPL)

IPL is commonly used a non-invasive light-based technology widely used in dermatology for treating vascular and pigmented lesions.(Raulin et al., 2003)It operates on the principle of selective photo thermolysis, targeting chromophores such as melanin and hemoglobin.(Yamashita et al., 2006)Key parameters influencing IPL efficacy include wavelength, pulse duration, fluence, and spot size. (Gade et al., 2024)Proper adjustment is essential to maximize efficacy while minimizing adverse effects, particularly in darker skin types.Clinical studies have demonstrated that IPL is effective in treating axillary hyperpigmentation, with outcomes comparable to laser therapies but with improved patient comfort.(Amornpetkul et al., 2021a)

Combination therapy for hyperpigmentation

Combination therapy targets multiple pathways involved in hyperpigmentation and may enhance treatment outcomes. Studies have shown improved efficacy when combining topical agents with procedural treatments such as IPL or lasers. (Goldman et al., 2011)However, not all combinations yield synergistic effects. For example, some studies report no significant advantage of combining niacinamide with laser therapy compared to monotherapy.(S. R. Park et al., 2016)Axillary hyperpigmentation is a multifactorial condition primarily driven by chronic irritation and inflammation. Current treatments focus on reducing melanogenesis and removing existing pigment, with topical agents and light-based therapies being the main approaches. Niacinamide offers a safe and effective option due to its multifunctional properties, while IPL provides a non-invasive procedural alternative. Despite existing evidence, limited studies have evaluated their combined use in axillary hyperpigmentation, highlighting the need for further research.

RESEARCH METHODOLOGY

This prospective, randomized, split-site clinical trial evaluated treatment efficacy for axillary hyperpigmentation at Mae Fah Luang University Hospital, Asoke, Bangkok. Twenty-two adults with axillary hyperpigmentation were enrolled. Participants with active skin disease, recent dermatologic treatment, pregnancy, and infection were excluded from the study. The split-site design minimized inter-individual variability by allowing each participant to serve as their own

control. Using blocked randomization, one axilla received 5% niacinamide cream twice daily combined with intense pulsed light (IPL) therapy, while the contralateral side received 5% niacinamide cream alone. IPL sessions were performed at baseline, week 4, and week 8 using standardized parameters. Participants applied 5% niacinamide cream to both axillae for 12 weeks. Outcomes were assessed using melanin index measurements, standardized clinical photographs, Global Aesthetic Improvement Scale (GAIS), and patient satisfaction questionnaires. Safety and adverse events were monitored throughout the study. The investigators assessing the outcomes were blinded to treatment allocation to reduce assessment bias. Statistical significance was set at $p < 0.05$, and ethical approval (EC 25064-20/2025) was obtained from the Mae Fah Luang University Ethics Committee prior to study initiation.

RESEARCH RESULTS

Demographic Data

22 healthy participants (12 males and 10 females, with the average age of 31.95 ± 3.6 years) were enrolled. They all did not have any underlying disease, photosensitivity or drug induced photosensitivity, active skin condition or previous treatment at axilla.

Clinical Evaluation

Statistical analyses were performed using SPSS software (IBM, version 2.1.0) from Mae Fah Luang University, Chiang Rai, Thailand.

Table 1. Melanin Score measurement by statistical analysis compared between monotherapy and combination therapy (n=22)

	Monotherapy	Combination Therapy	Paired Difference $\pm$ SD	p-value(a)
	Mean $\pm$ SD	Mean $\pm$ SD		
Baseline	481.13 $\pm$ 122.14	483.04 $\pm$ 128.95	1.91 $\pm$ 6.81	0.80
4th week	459.45 $\pm$ 111.62	406.04 $\pm$ 105.26	-53.41 $\pm$ 6.36	<0.001
8th week	395.23 $\pm$ 93.72	343.77 $\pm$ 71.75	-51.46 $\pm$ 21.97	<0.001
12th week	339.59 $\pm$ 83.57	268.72 $\pm$ 46.87	-70.87 $\pm$ 36.7	<0.001
p-value(b)	<0.001	<0.001		

Data were analyzed using paired t-tests for between-group comparisons and repeated measures ANOVA for within-group analysis, with statistical significance set at $p < 0.05$. Both treatment groups demonstrated progressive improvement, with significant reductions over time within each group ($p < 0.001$). No significant baseline difference was observed between groups ($p > 0.05$). However, the combination therapy group showed significantly greater improvement from week 4 onward: week 4 (459.45 ± 111.62 vs. 406.04 ± 105.26), week 8 (395.23 ± 93.72 vs. 343.77 ± 71.75), and week 12 (339.59 ± 83.57 vs. 268.72 ± 46.87), all $p < 0.001$. The increasing difference over time suggests a stronger cumulative effect of combination therapy.

Table 2. Multiple comparison analysis (Post-hoc test) of melanin index (n=22)

Compare to		Monotherapy		Combination Therapy	
		Mean difference	p-value	Mean difference	p-value
Baseline	4th week	-22.13	0.542	-77	<0.05
Baseline	8th week	-85.91	<0.05	-139.27	<0.001
Baseline	12th week	-141.54	<0.001	-214.17	<0.001
4th week	8th week	-64.23	<0.05	-62.67	<0.05
4th week	12th week	-155.86	<0.001	-137.32	<.0001
8th week	12th week	-55.63	<0.05	-75.05	<0.001

Note: Significant at $p < 0.05$, Post-hoc comparisons performed following repeated measures analysis. Lower melanin index indicate greater improvement. According to the multiple comparison analysis, Combination therapy demonstrates rapid and sustained improvement with statistically significant differences across all time points. Monotherapy shows consistent but slower improvement with statistically significant differences. ($p < 0.05$) starting from the week 4. However, combination therapy showed significantly greater reduction than monotherapy at all time points.

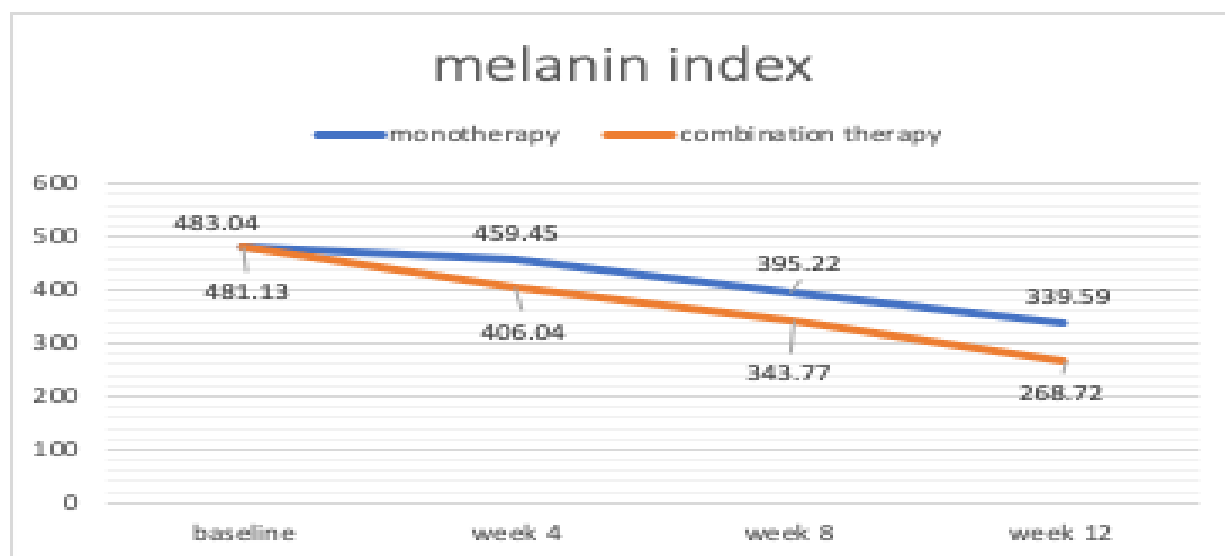
**Figure.1 Mean Value of melanin index Over Time Between Monotherapy and Combination Therapy**



Figure 2 Clinical photograph demonstrating improvement in axillary hyperpigmentation before and after 12 weeks treatment of combination therapy

Table 3 GAIS between Monotherapy and Combination Therapy at week 12 (n=22)

GAIS	Monotherapy (n=22)	Combination Therapy (n=22)
1. Very much improved	2 (9.1%)	16 (36.4%)
2. Much improved	12 (54.5%)	6 (27.3%)
3. Improved	8	0
4. No change	0	0
5. Worse	0	0

GAIS assessment demonstrated greater aesthetic improvement in the combination therapy group.

Table 4 Statistical Analysis of GAIS at 12th week (n=22)

	Monotherapy (n=22)	Combination Therapy (n=22)	p-value
	Median (IQR)	Median (IQR)	
12 th week	2 (2-3)	1 (1-2)	<0.0001

Data was presented by Wilcoxon Signed Ranks Test. Significant p-value < 0.0001.

Table 5 Frequency of Participants' Satisfactory Score at 12th week (n=22)

Participants' Satisfactory Score	Monotherapy (n=22)	Combination Therapy (n=22)
Score 0= not satisfy	0	0
Score 1= mildly satisfy	6	0
Score 2= moderately satisfy	10	4
Score 3= greatly satisfy	6	18

4 reported “moderately satisfy” and 18 reported “greatly satisfy” in combination therapy group whereas 6 reported mildly satisfy, 10 reported “moderately satisfy” and 6 of them reported “greatly satisfy” in monotherapy group. Data was presented by Fisher’s Exact Test, p value <0.0001 .

Table 6 Pain Score

Pain score (0-10)	Monotherapy (n=22)	Combination Therapy (n=22)
Pain score 0-3	0	22
Pain score 4-6	0	0
Pain score 7-10	0	0

Pain scores were rated by 22 participants in combination therapy group but participants rated pain score 0-3 and it is transient and relieved within minutes after IPL therapy.

Table 7 Erythema

	Monotherapy (n=22)	Combination Therapy (n=22)
Slight Erythema	4	3

Those erythema or swelling were transient and relieved within minutes after application. No serious adverse events were seen in both therapies.

DISCUSSION & CONCLUSION

This study demonstrated that combination therapy using intense pulsed light (IPL) and 5% niacinamide was more effective than niacinamide monotherapy in improving axillary hyperpigmentation, as shown by melanin index reduction, clinical photography, GAIS scores, patient satisfaction, and safety outcomes. Twenty-two healthy participants aged 20–45 years with Fitzpatrick skin types II–V were enrolled in a prospective randomized split-site trial, where one axilla received IPL combined with 5% niacinamide cream and the contralateral side received niacinamide alone. Data were analyzed using paired t-tests and repeated measures ANOVA, with $p < 0.05$ considered statistically significant. Both groups showed progressive melanin reduction over time ($p < 0.001$), but combination therapy demonstrated significantly greater improvement from week 4 onward, with the treatment difference increasing through weeks 8 and 12, suggesting a cumulative therapeutic effect of combination therapy. The delayed statistically significant improvement observed after the fourth week may be related to the cumulative effects of gradual depigmentation of niacinamide (Boo, 2021), with selective photothermolysis effect of IPL (Amornpetkul et al., 2021a). As epidermal turnover typically requires approximately 4 weeks, the synergistic reduction in pigmentation became more clinically apparent during later follow-up visits. The findings are consistent with prior studies demonstrating the depigmenting effects of niacinamide (A T S U B A R A, 2002) and the effectiveness of IPL in treating pigmentary disorders (Lee et al., 2008). Compared with monotherapy, the combination approach appears to provide faster and more pronounced clinical improvement, supporting the concept of multimodal intervention targeting different stages of melanogenesis. However, the magnitude of benefit should be interpreted cautiously, as some previous studies have reported variable outcomes with combination therapies, suggesting that additive effects may depend on treatment parameters and patient characteristics. The split-site design strengthened internal validity by minimizing inter-

individual variability, but it may not fully eliminate local environmental or behavioral differences between axillae. Both treatments were well tolerated, with only mild and transient adverse effects, consistent with established safety profiles of IPL and niacinamide (Barikbin et al., 2019). Nevertheless, IPL carries a potential risk of post-inflammatory pigmentary alteration, particularly in darker skin types, which warrants careful parameter selection. This study has several limitations. Although the sample size was statistically calculated, the small number of participants may limit the generalizability of the findings. Further studies with larger sample sizes are recommended. The follow-up duration was short, preventing assessment of long-term efficacy and recurrence. In addition, objective measurements relied primarily on melanin index without histological confirmation, and patient-reported outcomes may be subject to bias. External factors such as friction, shaving habits, and product use were not strictly controlled and may have influenced results. In conclusion, IPL combined with 5% niacinamide appears to be more effective than niacinamide alone for treating axillary hyperpigmentation. While the results are promising, further large-scale, long-term studies are required to validate these findings and optimize treatment protocols for broader clinical application.

REFERENCES

- T. Hakozaki, L. Minwalla, J. Zhuang, M. Chhoa, A. Matsubara, K. Miyamoto, A. Greatens, G.G. Hillebrand, D.L. Bissett, R.E. Boissy, The effect of niacinamide on reducing cutaneous pigmentation and suppression of melanosome transfer, *British Journal of Dermatology*, Volume 147, Issue 1, 1 July 2002, Pages 20–31.
- Amornpetkul, W., Kanokrungeesee, S., Kamanamool, N., Udompataikul, M., & Rojhirunsakool, S. (2021a). Comparison between the use of intense pulsed light and Q-switched neodymium-doped yttrium aluminum garnet laser for the treatment of axillary hyperpigmentation. *Journal of Cosmetic Dermatology*, 20(9), 2785–2793. <https://doi.org/10.1111/jocd.13981>
- Arora, P., Sarkar, R., Garg, V., & Arya, L. (2012). Lasers for treatment of melasma and post-inflammatory hyperpigmentation. *Journal of Cutaneous and Aesthetic Surgery*, 5(2), 93. <https://doi.org/10.4103/0974-2077.99436>
- Bains, P., Kaur, M., Kaur, J., & Sharma, S. (2018). Nicotinamide: Mechanism of action and indications in dermatology. *Indian Journal of Dermatology, Venereology and Leprology*, 84(2), 234–237. https://doi.org/10.4103/ijdv.IJDVL_286_17
- Barikbin, B., Akbari, Z., Vafaei, R., & Razzaghi, Z. (2019). The efficacy of IPL in periorbital skin rejuvenation: An open-label study. *Journal of Lasers in Medical Sciences*, 10(4), S64–S67. <https://doi.org/10.15171/jlms.2019.S12>
- Boo, Y. C. (2021). Mechanistic basis and clinical evidence for the applications of nicotinamide (Niacinamide) to control skin aging and pigmentation. In *Antioxidants* (Vol. 10, Number 8). MDPI. <https://doi.org/10.3390/antiox10081315>
- Castaneda-Cazares, J. P., Lárraga-Piñones, G., Ehnis-Pérez, A., Fuentes-Ahumada, C., Oros-Ovalle, C., Smoller, B. R., & Torres-Álvarez, B. (2013a). Topical niacinamide 4% and desonide 0.05% for treatment of axillary hyperpigmentation: A randomized, double-blind, placebo-controlled study. *Clinical, Cosmetic and Investigational Dermatology*, 6, 29–36. <https://doi.org/10.2147/ccid.s39246>

- Cichorek, M., Wachulska, M., Stasiewicz, A., & Tymińska, A. (2013). Skin melanocytes: Biology and development. *Postepy Dermatologii i Alergologii*, 30(1), 30–41. <https://doi.org/10.5114/pdia.2013.33376>
- Evans, R. L., Marriott, R. E., & Harker, M. (2012). Axillary skin: Biology and care. In *International Journal of Cosmetic Science* (Vol. 34, Number 5, pp. 389–395). <https://doi.org/10.1111/j.1468-2494.2012.00729.x>
- Gade, A., Vasile, G. F., Hohman, M. H., & Rubenstein, R. (2024). *Intense Pulsed Light (IPL) Therapy Continuing Education Activity*.
- Gehring, W. (2004). Nicotinic acid/niacinamide and the skin. In *Blackwell Publishing Ltd • Journal of Cosmetic Dermatology* (Vol. 3).
- Goldman, M. P., Gold, M. H., Palm, M. D., Colón, L. E., Preston, N., Johnson, L. A., & Gottschalk, R. W. (2011). Sequential treatment with triple combination cream and intense pulsed light is more efficacious than sequential treatment with an inactive (control) cream and intense pulsed light in patients with moderate to severe melasma. *Dermatologic Surgery*, 37(2), 224–233. <https://doi.org/10.1111/j.1524-4725.2010.01849.x>
- James, A. G., Pople, J. E., Parish, W. E., Moore, A. E., & Dunbar, N. (2006). Histological evaluation of hyperpigmentation on female Filipino axillary skin ¹. *International Journal of Cosmetic Science*, 28(4), 247–253. <https://doi.org/10.1111/j.1467-2494.2006.00328.x>
- Land, E. J., & Riley, P. A. (2000). *Spontaneous Redox Reactions of Dopaquinone and the Balance between the Eumelanin and Pheomelanin Pathways*.
- Lee, J., Jung, E., Lee, H., Seo, Y., Koh, J., & Park, D. (2008). Evaluation of the effects of a preparation containing asiaticoside on periocular wrinkles of human volunteers. In *International Journal of Cosmetic Science* (Vol. 30).
- Moolla, S., & Miller-Monthrope, Y. (2022). Dermatology: how to manage facial hyperpigmentation in skin of colour. *Drugs in Context*, 11, 1–14. <https://doi.org/10.7573/dic.2021-11-2>
- Naing, H. L., & Fah, M. (2021). *THE EFFICACY AND SAFETY OF PICOSECOND LASER USING COMBINATION OF 1064 AND 532 NM FOR AXILLARY HYPERPIGMENTATION MASTER OF SCIENCE IN DERMATOLOGY SCHOOL OF ANTI-AGING AND REGENERATIVE MEDICINE*.
- Nautiyal, A., & Wairkar, S. (2021a). Management of hyperpigmentation: Current treatments and emerging therapies. In *Pigment Cell and Melanoma Research* (Vol. 34, Number 6, pp. 1000–1014). John Wiley and Sons Inc. <https://doi.org/10.1111/pcmr.12986>
- Park, J. H., Kim, J. I., & Kim, W. S. (2016). Treatment of persistent facial postinflammatory hyperpigmentation with novel pulse-in-pulse mode intense pulsed light. *Dermatologic Surgery*, 42(2), 218–224. <https://doi.org/10.1097/DSS.0000000000000627>
- Park, J. Y., Park, J. H., Kim, S. J., Kwon, J. E., Kang, H. Y., Lee, E. S., & Kim, Y. C. (2017). Two histopathological patterns of postinflammatory hyperpigmentation: epidermal and dermal. *Journal of Cutaneous Pathology*, 44(2), 118–124. <https://doi.org/10.1111/cup.12849>
- Park, S. R., Kim, H. J., Park, H. K., Kim, J. Y., Kim, N. S., Byun, K. S., Moon, T. K., Byun, J. W., Moon, J. H., & Choi, G. S. (2016). Classification by causes of dark circles and appropriate evaluation method of dark circles. *Skin Research and Technology*, 22(3), 276–283. <https://doi.org/10.1111/srt.12258>

- Pérez-Bernal, A., Muñoz-Pérez, M. A., & Camacho, F. (2000). *American Journal of Clinical Dermatology* 1: 261-268, Sep-Oct 2000.
- Raulin, C., Greve, B., & Grema, H. (2003). IPL technology: A review. In *Lasers in Surgery and Medicine* (Vol. 32, Number 2, pp. 78–87). <https://doi.org/10.1002/lsm.10145>
- Turner, G. A., Moore, A. E., Marti, V. P. J., Paterson, S. E., & James, A. G. (2006). Impact of shaving and anti-perspirant use on the axillary vault. In *International Journal of Cosmetic Science* (Vol. 29).
- Wohlrab, J., & Kreft, D. (2014). Niacinamide-mechanisms of action and its topical use in dermatology. In *Skin Pharmacology and Physiology* (Vol. 27, Number 6, pp. 311–315). S. Karger AG. <https://doi.org/10.1159/000359974>
- Yamashita, T., Negishi, K., Hariya, T., Kunizawa, N., Ikuta, K., Yanai, M., & Wakamatsu, S. (2006). Intense pulsed light therapy for superficial pigmented lesions evaluated by reflectance-mode confocal microscopy and optical coherence tomography. *Journal of Investigative Dermatology*, 126(10), 2281–2286. <https://doi.org/10.1038/sj.jid.5700414>

Data Availability Statement: The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

Conflicts of Interest: The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Publisher’s Note: All claims expressed in this article are solely those of the authors and do not necessarily represent those of their affiliated organizations, or those of the publisher, the editors and the reviewers. Any product that may be evaluated in this article, or claim that may be made by its manufacturer, is not guaranteed or endorsed by the publisher.



Copyright: © 2026 by the authors. This is a fully open-access article distributed under the terms of the Attribution-NonCommercial-NoDerivatives 4.0 International (CC BY-NC-ND 4.0).