Dermatological Health, 2025, Volume 3, Issue 3
http://ojs.bbwpublisher.com/index.php/DH
Online ISSN: 2981-8206
Print ISSN: 3083-4775

Analysis of Clinical Effectiveness of Intense Pulsed Light Combined with Q-Switched Laser in Facial Skin Beauty Treatment

Xuefen Wang, Yaqi Yu, Yan Ma, Ruonan Wang, Bingbing Gao, Xuemei Ma

PLA Army Hospital 946, Yining 835000, Ili Kazakh Autonomous Prefecture, Xinjiang Uygur Autonomous Region, China

Abstract: *Objective*: To investigate and analyze the clinical effectiveness of intense pulsed light combined with Q-switched laser in facial skin beauty treatment. *Methods*: A total of 197 patients with post-acne pigmented spots and erythema seeking facial skin beauty treatment in our hospital from May 2024 to May 2025 were selected and randomly divided into observation group (99 cases) and control group (98 cases) according to the envelope method. The control group was treated with a Q-switched laser, while the observation group was treated with intense pulsed light combined with a Q-switched laser. The clinical effectiveness, Melasma Area and Severity Index (MASI) score, and skin barrier function (stratum corneum water content, transepidermal water loss, epidermal sebum content) were compared between the two groups. *Results*: The clinical effectiveness of the observation group was significantly better than that of the control group ($P < 0.05$). There was a statistically significant difference in the decrease of MASI scores between the observation group and the control group ($P < 0.05$). After treatment, the levels of transepidermal water loss and epidermal sebum content in both groups were significantly reduced, and the water content of the stratum corneum was significantly increased. The improvement of each index in the observation group was better than that in the control group ($P < 0.05$). *Conclusion*: The combination of intense pulsed light and Q-switched laser can not only improve the clearance rate of skin lesions, but also achieve an overall improvement in skin barrier function by promoting collagen regeneration, optimizing epidermal hydration function, and sebum metabolism.

Keywords: Facial skin; Intense pulsed light; Q-switched laser; Clinical effectiveness

Online publication: October 17, 2025

1. Introduction

Among facial skin problems, post-acne erythema and pigmentation are the most common concerns in the field of cosmetology, severely affecting patients' appearance and mental health [1]. With high energy and ultra-short pulse width, the Q-switched laser effectively targets pigment groups through selective photothermal action. Micro-pigment groups are cleared through the body's metabolism, showing significant effects in treating pigmented skin lesions [2]. However, the incidence of postoperative inflammatory pigmentation is relatively

high, posing a risk of anti-blackening, and its solo application has limitations: it has a poor effect on stubborn vascular problems, a small treatment range, low efficiency, and easy to miss when dealing with large lesions, and its high-energy characteristics may damage the epidermal barrier with insignificant repair effects [3]. Intense Pulsed Light (IPL) is a kind of incoherent broadband spectrum light, with a wavelength range typically from visible to near-infrared. Its advantage lies in being able to simultaneously target multiple chromophores in the skin. Through photothermal action, IPL can promote the constriction and closure of dilated blood vessels, thereby effectively improving erythema. It can also gently heat melanin and inhibit its activity, promoting the catabolism of pigment particles and improving pigmentation. Furthermore, the photothermal effect of IPL can stimulate the activity of dermal fibroblasts, promoting collagen regeneration and remodeling, which potentially benefits skin texture improvement and barrier function enhancement [4]. Therefore, this study explores the intervention effect of intense pulsed laser combined with Q-switched laser on facial skin by adopting this combined therapy for patients seeking skin beauty treatment for post-acne pigmented spots and erythema at our hospital from May 2024 to May 2025. It aims to provide evidence for clinical treatment selection. The specific report is as follows.

2. Materials and methods

2.1. General information

A total of 197 patients seeking cosmetic treatment for post-acne pigmented spots and erythema on their faces, who were diagnosed and treated in our hospital from May 2024 to May 2025, were selected. They were randomly divided into an observation group and a control group using the envelope method, with 99 patients in the observation group and 98 patients in the control group. There was no statistically significant difference in basic patient information between the two groups ($P > 0.05$), as shown in **Table 1**. This study was approved by the hospital ethics committee and complied with the relevant ethical principles of the Helsinki Declaration.

Table 1. Comparison of general information between the two groups (Mean ± SD/n %)

Characteristics	Observation group (n=99)	Control group (*n*=98)	t/x^2	*P*-value
Gender (Male/Female)	9 / 90	10 / 88	0.070	0.791
Age (years)	18-41	19-43	0.103	0.918
	30.15 ± 4.66	30.22 ± 4.84		
Disease Duration (months)	8.5-15.5	8.0-15.5	0.523	0.602
	11.45 ± 1.42	11.56 ± 1.53		
Type of Lesion				
Post-acne erythema	52	55	0.257	0.612
Post-inflammatory hyperpigmentation	47	43		

2.2. Inclusion and exclusion criteria

Inclusion criteria: (1) Age between 18 and 45 years old. (2) Diagnosed with post-inflammatory hyperpigmentation and/or erythema due to acne. (3) Agree to sign the informed consent form and complete the full course of treatment and follow-up. (4) Have not used any drugs that affect the skin barrier, such as vitamin

A acid and fruit acid, within one month before treatment. (5) No history of photosensitive diseases. (6) No active infection or damage in the treatment area.

Exclusion criteria: (1) Comorbidities with non-inflammatory pigmented diseases such as chloasma and nevus of Ota. (2) Scar constitution or history of hypertrophic scarring. (3) Have received facial treatments such as laser or chemical peeling within the past three months. (4) Long-term oral anticoagulant drugs or glucocorticoids. (5) Tattoos or permanent fillers in the treatment area. (6) Presence of immunodeficiency diseases or history of malignant tumors.

2.3. Methods

All enrolled patients need to thoroughly clean their facial skin before treatment and use professional eye masks to protect their eyes. For patients with low pain tolerance, compound lidocaine cream can be evenly applied to the treatment area for superficial anesthesia before treatment, with a sealing time of no less than 1 hour. The setting of treatment parameters should be adjusted according to the individual situation of the patient. Before treatment, a test spot is routinely performed in a non-obvious area, such as the front of the ear or forehead, to determine the appropriate energy density and ensure safe and effective treatment. Immediately after treatment, apply an ice pack or cold spray device to the treatment area for 15–30 minutes to reduce thermal damage reaction. For patients receiving Q-switched laser treatment, they are instructed to avoid water exposure and strict sun protection for 3–5 days after surgery, and use gentle cleansing products 2 weeks after surgery.

The control group patients received Q-switched laser treatment: a clinically commonly used Q-switched laser therapy instrument was selected, with a laser wavelength set at 532 nm (1064 nm for deep dermal pigmented spots), laser energy of 300–350 mJ, pulse width range of 6-10 ns, spot diameter of 2–3 mm, and frequency of 3–5 HZ. The energy density was personalized based on the test spot reaction and patient tolerance, typically starting at 1.0–1.5 J/cm^2 and gradually adjusted until the scanned lesion reached epidermal blasting. During the operation, the laser handle was kept perpendicular to the irradiation, and the target area was uniformly scanned once. The treatment frequency was once every 4 weeks, and a total of 3 treatments were completed based on the improvement of the patient's skin lesions.

The observation group patients received intense pulsed light combined with Q-switched laser treatment: an intense pulsed light instrument (GP666C8 model) was used with a multifunctional optical head with a wavelength range of 500–1200 nm. The parameters were selected based on the type of skin lesion — "redness removal" mode (energy density 8–10 J/cm^2) was used for post-acne erythema, and "spot removal" mode (energy density 10–12 J/cm^2) was used for pigmentation. The pulse width was set to 10–15 milliseconds (within the device's allowable range of 3–25 milliseconds), and the spot area was a 5.0cm×1.0cm rectangle. During the operation, the handpiece was kept in contact with the skin, and the spot overlap rate was controlled at 10%–15%. The endpoint of the treatment was determined by slight redness or darkening of the skin. Immediately after the intense pulsed light treatment, the cold gel was cleaned and removed, followed by Q-switched laser treatment on the same area. The instrument selection, parameter settings (laser wavelength of 532 nm (1064 nm for deep dermal pigmented spots), laser energy of 200–300 mJ, pulse width range of 6–10 ns, spot diameter of 2–3 mm, frequency of 3–5 HZ, and personalized energy density based on test spot reaction and patient tolerance), and operational specifications were exactly the same as those of the control group. The combined treatment frequency was also once every 4 weeks, with a total of 3 treatments.

After the treatment, a 4–5 °C cold air blower was immediately used to blow air on the treated area for 5–8

minutes to reduce tissue swelling and burning pain. Strict sun protection was implemented, and the treated area was kept away from water for 3–5 days. Special water-avoidance care was not required for intense pulsed light treatment as there was no epidermal damage.

2.4. Observation indices

2.4.1. Clinical effectiveness

Observe and compare the clinical effectiveness of the two patient groups, using the modified Melasma Area Severity Index (MASI) score to evaluate the improvement of pigmentation. Two dermatologists who did not participate in the treatment independently evaluated the pigment area proportion (0–6 points) and color depth (0–4 points) in four areas of the patient's face (forehead, right cheek, left cheek, chin) under standard lighting conditions. The formula for calculating the total MASI score is: forehead area × depth × 0.3 + right cheek area × depth × 0.3 + left cheek area × depth × 0.3 + chin area × depth × 0.1. Cure is defined as a ≥95% reduction in MASI score, marked effectiveness as a ≥70% reduction, effectiveness as a ≥30% reduction, and ineffectiveness as a <30% reduction.

2.4.2. MASI score

Compare the MASI scores of the two patient groups before and after treatment. The scoring criteria are as described above. The reduction rate (%) = (pre-treatment score - post-treatment score) / pre-treatment score × 100%.

2.4.3. Skin barrier function

Observe and compare the skin barrier function of the two patient groups before and after treatment, including stratum corneum water content, transepidermal water loss, and epidermal sebum content. Before treatment and one month after the last treatment, patients were asked to sit quietly for 30 minutes in a constant temperature and humidity environment (typically 25 ± 1℃, relative humidity 50 ± 5%). The Glossymeter SEM575 was used to measure the stratum corneum water content (units: %), transepidermal water loss (units: $g/h \cdot m^2$), and epidermal sebum content (units: $\mu g/cm^2$) of the patients' cheek skin in a fixed target area. The recorded values were compared between groups and within groups before and after treatment.

2.5. Statistical methods

This hospital conducted a statistical analysis using SPSS 21.0 software package. Measurement data were represented using (Mean ± SD), assuming a normal distribution. The comparison between groups was performed using the t-test. Count data were represented using relative numbers, and the comparison between groups was done using x^2 test. The comparison of clinical efficacy was performed using the rank sum test. A *P*-value less than 0.05 was considered statistically significant.

3. Results

3.1. Comparison of clinical effectiveness between the two groups

The clinical effectiveness of the observation group was significantly better than that of the control group ($P < 0.05$) (**Table 2**).

Table 2. Comparison of clinical effectiveness between the two groups [n(%)]

Group	n	Cure	Markedly Effective	Effective	Ineffective	Total Effective
Observation	99	41 (41.41)	33 (33.33)	23 (23.23)	2 (2.02)	97 (97.98)
Control	98	26 (26.53)	37 (37.76)	25 (25.51)	10 (10.20)	88 (89.80)
x^2 value						5.766
P value						0.016

3.2. Comparison of MASI scores between the two groups

The MASI score of the observation group decreased from a baseline of 8.52 ± 1.23 to 2.15 ± 0.87, with a decrease of 75.20%. The control group decreased from 8.48 ± 1.17 to 4.36 ± 1.05, with a decrease of 48.58%. The difference in the magnitude of decrease between the groups was statistically significant ($P < 0.05$) (**Table 3**).

Table 3. Comparison of MASI scores before and after treatment between the two groups (Mean ± SD)

Group	n	Before treatment	After treatment	Reduction value	Reduction rate (%)
Observation	99	8.52 ± 1.23	2.15 ± 0.87*	6.37 ± 0.98	75.20 ± 5.12
Control	98	8.48 ± 1.17	4.36 ± 1.05*	4.12 ± 0.87	48.58 ± 4.96
t-value		0.234	16.093	16.202	37.058
P-value		0.815	<0.001	<0.001	<0.001

Note: Compared with the same group before treatment, *$P < 0.05$

3.3. Comparison of skin barrier function levels between the two groups

Before treatment, there was no significant difference in skin barrier function levels between the two groups ($P > 0.05$). After treatment, the levels of TEWL and epidermal sebum content decreased significantly, while the water content of the skin's stratum corneum increased significantly in both groups. However, the improvement in various indicators in the observation group was better than that in the control group ($P < 0.05$) (**Table 4**).

Table 4. Comparison of skin barrier function levels before and after treatment between the two groups (Mean ± SD)

Group	n	Stratum Corneum Hydration (%)		TEWL (g/h·m²)		Epidermal Sebum Content (μg/cm²)	
		Before Treatment	After Treatment	Before Treatment	After Treatment	Before Treatment	After Treatment
Observation	99	14.08 ± 1.51	16.49 ± 1.98	49.22 ± 2.11	41.93 ± 2.87	112.98 ± 8.77	104.25 ± 7.08
Control	98	14.26 ± 1.63	15.02 ± 2.04	48.94 ± 2.26	44.59 ± 3.15	112.54 ± 8.41	109.11 ± 6.45
t-value		0.804	5.132	0.899	6.197	0.359	5.035
P-value		0.422	<0.001	0.370	<0.001	0.720	<0.001

Note: Compared with the same group before treatment, *$P < 0.05$

4. Discussion

The pathological basis of post-acne erythema and pigmented patches on the face is the continuous dilation of

microvessels in the dermis and abnormal melanocyte activity. Mediators such as histamine released during acne inflammation widen the gaps between capillary endothelial cells and increase permeability, leading to erythrocyte extravasation and hemosiderin deposition. Inflammatory factors also stimulate the activity of tyrosinase in melanocytes, accelerating melanin synthesis and transport, and forming erythema and pigmented patches [5].

Currently, Q-switched lasers are often used clinically to treat such problems, with the core mechanism being selective photothermolysis: the Q-switched wavelength can effectively penetrate to the deep dermis, and high-energy photons target and break up melanosomes, which are then metabolized and excreted through the lymphatic system [6]. However, research has found that the use of Q-switched lasers alone has limitations: it is not effective for stubborn redness issues; point scanning results in uneven energy distribution and easy to miss stubborn skin lesions; the thermal damage of high-energy lasers can temporarily destroy the lipid structure of the stratum corneum, potentially causing pigmentation deepening and rebound phenomenon [7]. Intense pulsed light therapy inhibits melanin activity, promotes the catabolism of pigment particles, promotes collagen contraction and closure of blood vessel walls, and improves erythema through photothermal effects; however, its depth is limited by wavelength, and it has low efficiency for deep dermal problems. Therefore, for deep pigmentation or stubborn patches, intense pulsed light combined with Q-switched laser is needed, and the synergy between the two can reduce the risk of rebound pigmentation.

This study innovatively used the MASI scoring system to quantify the degree of pigmentation improvement. The data showed that the MASI score reduction rate in the combined treatment group reached 75.20%, which was significantly higher than that in the Q-switched laser group (48.58%). This result confirms the synergistic mechanism of IPL: its broad-spectrum light energy preheats pigment targets, lowers the blasting threshold of subsequent Q-switched lasers, and simultaneously closes blood vessels to reduce the release of inflammatory factors, thereby reducing the risk of pigment rebound [8].

This study adopts sequential therapy combining intense pulsed light (IPL) and Q-switched laser, based on the complementary and synergistic effects of their photonic energy. IPL serves as a precursor, targeting hemoglobin and melanin with a broad spectrum of 540–570 nm. During treatment, the millisecond pulse width of IPL generates a thermal effect, promoting the contraction of collagen in blood vessel walls and occlusion of the lumen. In terms of pigment processing, low-energy-density IPL preheats melanin and decomposes superficial pigments, reducing pigment competition for light absorption during Q-switched laser treatment. Additionally, the thermal effect of IPL activates fibroblast TLR4 receptors, up-regulates related pathways, promotes collagen synthesis, and matrix remodeling. This explains the mechanism behind the high moisture content of the stratum corneum in the combined group: newly formed collagen enhances connectivity and improves water-holding capacity, and the repaired barrier forms a virtuous cycle of water metabolism [9].

In terms of sebum regulation, the epidermal sebum content of the combined group is further reduced compared to the control group, which may be related to the thermal effect of intense pulsed laser: local heating can temporarily inhibit PPARγ activity in sebaceous gland cells, reduce the expression of enzymes related to lipid synthesis, and promote the softening of gland duct keratinization, improving lipid excretion patency. It is worth noting that the synergistic effect of the two therapies is also reflected in the difference in clinical efficacy: the total effective rate of the combined group is significantly higher than that of the control group. This advantage stems from the dual optimization of IPL pretreatment on therapeutic targets: on the one hand, it reduces hemoglobin's competitive absorption of subsequent Q-switched laser energy by closing superficial

blood vessels, allowing more energy to be focused on deep pigments; on the other hand, it lowers the threshold energy required for pigment particle explosion through preheating sensitization, enabling the Q-switched laser to achieve more thorough treatment effects at a lower safe energy level [10].

5. Conclusion

In summary, the therapeutic advantages of combining intense pulsed light and Q-switched laser are not only reflected in a higher lesion clearance rate but also in the overall improvement of skin barrier function by promoting collagen regeneration, optimizing epidermal hydration, and sebum metabolism.

Disclosure statement

The authors declare no conflict of interest.

References

[1] Amiri R, Khalili M, Mohammadi S, et al., 2022, Treatment Protocols and Efficacy of Light and Laser Treatments in Post-acne Erythema." Journal of Cosmetic Dermatology, 21(2): 648–656.

[2] Fang H, Chen B, 2021, Comparison of the Efficacy of Q-switched Pulsed Laser and Two Wavelengths of Intense Pulsed Light in The Treatment of Post-acne Erythema and Pigmentation. Journal of Cosmetic Medicine, 30(5): 90–94.

[3] Zhang YX, Sun L, 2022, Clinical Application of Laser and Intense Pulsed Light in the Treatment of Rosacea. Chinese Journal of Laser Medicine, 31(2): 112–116.

[4] Yang RQ, Wang X, Yang YT, et al., 2021, Short-term Efficacy Analysis of Ultrasound-guided Vitamin E Import on Pigmentation in Patients with Second-degree Facial Burns. Journal of Third Military Medical University, 43(11): 1039–1044.

[5] Wang N, Peng LL, 2023, Application Effect of Intense Pulsed Light in Facial Skin Beauty and its Influence on Patients' Prognosis Satisfaction. Chinese Medicine Guide, 21(8): 102–104.

[6] Han P, Zhang J, Wang YL, et al., 2022, Analysis of the Effectiveness and Safety of Intense Pulsed Light Combined with Q-switched Laser in the Treatment of Freckles. Chinese Journal of Cosmetic Medicine, 31(5): 6–9.

[7] Murray TN, Lohray R, Schultz KP, et al., 2024, Complications of Chemical Peels, Lasers, and Energy-Based Device Procedures Performed by Core Cosmetic Physicians: A Retrospective Analysis. Lasers in Surgery and Medicine, 56(7): 619–624.

[8] Zhu Q, Pang F, Chen Y, 2025, Observation on the Efficacy of Intense Pulsed Light Combined with Q-switched Laser in the Treatment of Post-acne Pigmentation. Chinese Journal of Cosmetic Medicine, 34(3): 116–119.

[9] Meng Q, Zhou YN, Zhou TK, et al., 2023, The Effect of Intense Pulsed Light Combined with Q-switched Laser on Facial Freckles and Its Influence on Skin Barrier Function. Chinese Journal of Cosmetic Medicine, 32(12): 115–118.

[10] Shen B, Tian C, 2021, Comparison of the Efficacy of Intense Pulsed Light and Q-switched Laser in the Treatment of Freckles. Journal of Dermatology and Venereology, 43(4): 525–526.