



**A SPLIT-FACED, COMPARATIVE STUDY OF PULSED DYE LASER:
595 NM AND DRAGON'S BLOOD SERUM FOR ACNE-INDUCED
POST INFLAMMATORY ERYTHEMA**

WAI ZIN PHYO

**MASTER OF SCIENCE
IN
DERMATOLOGY**

**SCHOOL OF ANTI-AGING AND REGENERATIVE MEDICINE
MAE FAH LUANG UNIVERSITY**

2025

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**THIS THESIS IS A PARTIAL FULFILLMENT OF
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**THESIS APPROVAL
MAE FAH LUANG UNIVERSITY
FOR
MASTER OF SCIENCE
IN
DERMATOLOGY**

Thesis Title: A Split-faced, Comparative Study of Pulsed Dye Laser: 595 nm and
Dragon's Blood Serum for Acne-induced Post Inflammatory Erythema

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Wai Zin Phyoo

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ABSTRACT

Background: Postacne erythema (PAE), or post-inflammatory erythema (PIE), is a common sequela of acne characterized by persistent redness due to vascular dilation and dermal inflammation. This condition often affects patients' quality of life due to its cosmetic impact. Existing treatments, including topical agents and laser therapies, provide inconsistent results, highlighting the need for more effective solutions. The Pulse Dye Laser (PDL), which employs selective photothermolysis to target vascular structures, and Dragon's Blood Serum (DBS), a plant-based extract with anti-inflammatory and wound-healing properties derived from *Croton lechleri*, are promising options for PAE management. However, direct comparative evidence for these treatments is limited.

Objectives: This study aims to compare the efficacy of PDL and DBS in reducing erythema intensity in patients with acne-induced PAE. Secondary objectives include evaluating treatment-related side effects and patient satisfaction.

Methods: This prospective, randomized, split-face study involves 12 participants with acne-induced PAE. Each participant undergoes PDL treatment on one side of the face and DBS application on the other, with treatment sides assigned randomly. The study spans nine weeks, comprising baseline assessments, three treatment sessions at three-week intervals, and a one-month follow-up. Outcomes include clinical photography, erythema index measurements, and patient-reported satisfaction, pain, and perceived improvement. Statistical analyses, including paired t-tests and ANOVA, will determine the comparative effectiveness of the two treatments.

Keywords: Postacne Erythema, Pulse Dye Laser, Dragon's Blood Serum, Split-face Study, Vascular Therapy, Anti-inflammatory Treatment



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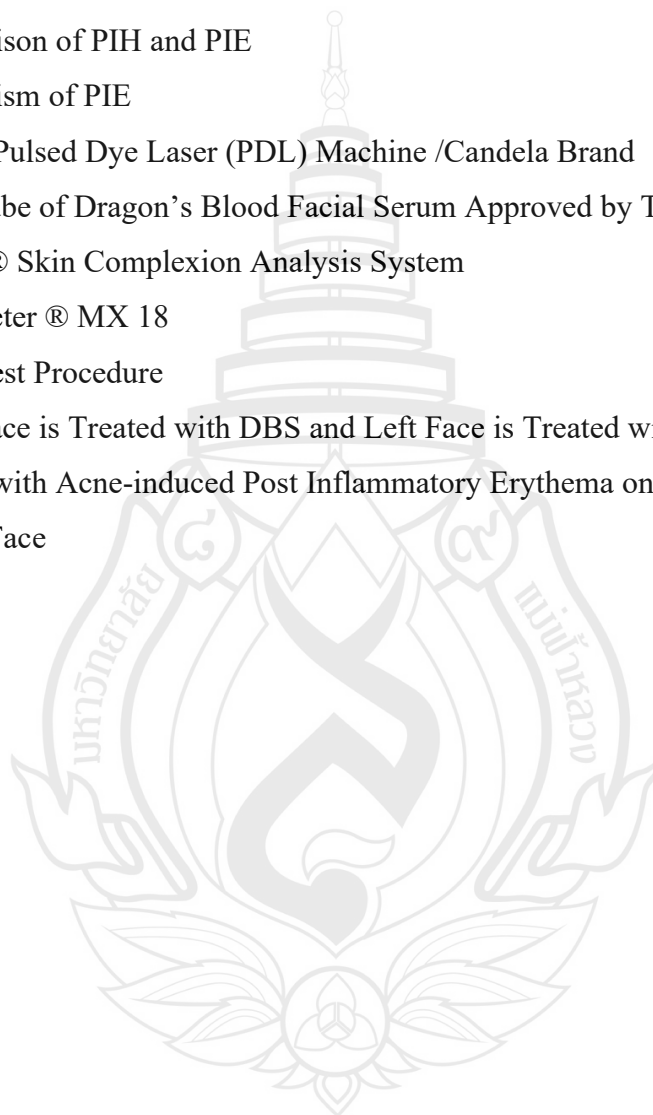


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CHAPTER 1

INTRODUCTION

1.1 Background

Post-inflammatory erythema (PIE) is a common, persistent sequela of inflammatory acne vulgaris characterised by erythematous macules that may persist for months to years following resolution of active lesions (1). Driven by persistent dilation of superficial papillary dermal capillaries — rather than melanin overproduction — PIE is mechanistically distinct from post-inflammatory hyperpigmentation and carries meaningful psychosocial burden (1-2). Despite high prevalence, no universally accepted standard of care exists (1).

The 595-nm pulsed dye laser (PDL) is mechanistically well-suited to PIE: selective photothermolysis preferentially absorbs oxyhemoglobin within superficial dermal vessels, inducing targeted vascular coagulation with minimal collateral injury (3). Clinical evidence supports efficacy: Yoon et al. reported 90% improvement with two 595-nm PDL sessions ($p < 0.05$); (4) Park et al. confirmed significant Mexameter erythema index (EI) improvement in a split-face pilot, with 75% of patients rating outcomes as good or excellent; (5) Clementi et al. reported 70.4% excellent clearance over 3–4 sessions (6). El Samahy et al. demonstrated that even a single low-fluence PDL session reduced serum CTACK levels ($p < 0.001$), suggesting immunomodulatory effects beyond direct vascular coagulation (7). However, a critical clinical gap remains: the temporal kinetics of the PDL erythema response across sequential sessions — specifically, how early significant reduction is first detectable, whether the response is linear or accelerating, and when the peak treatment effect is reached — have not been prospectively defined within the same individuals. This gap directly limits clinicians' ability to counsel patients on expected improvement timelines, identify early non-responders, and determine optimal session frequency.

Non-PDL vascular and topical pharmacological modalities have also demonstrated efficacy. Topical brimonidine tartrate 0.2%, an alpha-2 adrenergic

agonist causing vasoconstriction, produced statistically significant erythema reduction in a clinical trial of 30 PAE patients, with greater improvement than a rosacea comparator group (7). A systematic review of topical timolol maleate 0.5% across five studies involving 205 patients found beneficial effects on PAE with good tolerability (8). Topical isostearyl-L-ascorbic acid (ISAA) 2% gel resulted in remarkable PIE improvement in 48% of patients over three months with no adverse events (9). A silymarin antioxidant serum produced a 60% reduction in investigator-assessed erythema at four weeks in acne patients on prescription therapies (10). A retinol, niacinamide, ceramide and dipotassium glycyrrhizinate combination achieved approximately 10.3% redness reduction at four weeks ($p < 0.05$) in 43 women with acne (11). A 6% broccoli stem extract cream reduced erythema index significantly over eight weeks in post-acne macular scars ($p < 0.001$) with 100% patient satisfaction (12).

Dragon's Blood Serum (DBS), derived from *Croton lechleri* resin, has been proposed as a topical anti-inflammatory comparator. Its phytochemical constituents — proanthocyanidins and phenolic compounds — have been reported to inhibit pro-inflammatory cytokines and reduce oxidative stress in experimental settings (13). A randomised double-blind placebo-controlled trial of Dragon's blood cream ($n = 60$) demonstrated significantly accelerated wound healing and reduction in inflammatory signs versus placebo, (14) providing the primary clinical evidence for anti-inflammatory activity of topical *Croton lechleri* formulations in human skin. No study has evaluated DBS in PIE as a primary indication. We therefore conducted a prospective, randomised, split-face pilot study with the primary aim of defining the temporal response kinetics of 595-nm PDL in acne-induced PIE across three sequential sessions — characterising when erythema reduction first becomes detectable, the trajectory of cumulative response, and the effect magnitude at peak treatment — using topical DBS as an anti-inflammatory comparator to contextualise the vascular response profile.

1.2 Research Question

In patients with acne-induced post-inflammatory erythema, how does the efficacy of pulse dye laser compare to that of Dragon's Blood serum in reducing erythema intensity?

1.3 Research Objectives

To Compare the clinical improvement of acne-induced post inflammatory erythema, effectiveness and satisfaction of the Pulsed dye laser: 595 nm with Dragon's Blood Serum

1.4 Hypothesis

1. Pulsed dye laser has significant difference in clinical improvement of post-inflammatory erythema compared to Dragon's Blood Serum
2. Pulsed dye laser has effectiveness in clinical improvement of post inflammatory erythema more than Dragon's Blood Serum.
3. Pulsed dye laser has patients' satisfaction more than Dragon's Blood Serum.

1.5 Conceptual Framework

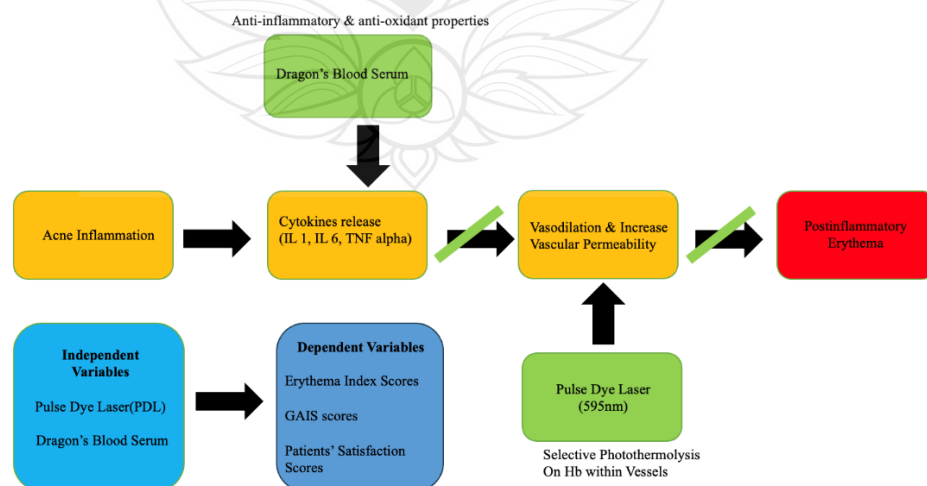


Figure 1.1 Conceptual Framework

1.6 The Scope of Research

This study is to compare efficacy of pulse dye laser (PDL) and Dragon's Blood serum and compares both methods in treatment of acne-induced post inflammatory erythema. The sample size, male and female volunteers are selected with age range 18-35 years using inclusion and exclusion criteria. Half side of the face will be treated with pulsed dye laser: 595 nm for total three sessions with 4weeks intervals at Mae Fah Luang University Hospital, Bangkok. On another side of the face, Dragon's blood serum is applied twice daily at night for 9 weeks. All of volunteers will be explained completely about possible benefits and effects of laser and serum before the treatment. Moreover, erythema index is measured by using Mexameter®MX18. Global Aesthetic Improvement Scale (GAIS) is done by investigator. For recording of score and clinical assessment scale, the VISIA complexion Analysis System is used. All parameters are taken and recorded at baseline, 3th week, 6th week and 19th week respectively. Clinical improvement of erythema lesions is independently evaluated by two masked dermatologists. Patients are asked to evaluated their satisfaction scores at the end of the study.

1.7 Variables in Study

1.7.1 Independent Variables

1. Pulse dye laser (PDL)
2. Dragon's blood serum (DBS)

1.7.2 Dependent Variables

1. Erythema Index (Mexameter® MX18)
2. Global Aesthetic Improvement Scale (VISIA Scan)
3. Patients' satisfaction scores

1.8 Term Definitions

1.8.1 Effectiveness (Desired Result)

Effectiveness in clinical trials is the measure of a medication's ability to produce desirable effects under real conditions or regular, everyday use. It is a measure of how well the medication works in practice in real patients.

1.8.2 Pulse Dye Laser (PDL)

Pulse dye laser is one type of laser that uses a concentrated beam of light which targets blood vessels while leaving the surrounding skin undamaged.

1.8.3 Dragon's Blood Serum (DBS)

Dragon's Blood Serum is a serum which contains an active compound that results from the extract of *Croton lechleri*.

1.8.4 Acne-induced post inflammatory erythema

It is a sequela of inflammatory acne. Lesion may appear red from angiogenesis as a part of the skin's normal healing response to dermal injury. Post inflammatory erythema may be self-limited but take months to years to completely resolve if it is left untreated.

1.8.5 Erythema Index

It is a score that offers a good method for assessing UVR induced erythema. Due to the development of a convenient hand-held spectrometer, it is possible that the method could be used for the grading of eczematous reactions in a clinical setting as well.

1.8.6 Definition of Global Aesthetic Improvement Scale (GAIS)

The Global Aesthetic Improvement Scale (GAIS) is a 5-point subjective assessment scale used by investigators or patients to evaluate the overall aesthetic improvement of a treated area compared with baseline appearance. It measures the degree of improvement following a treatment based on clinical judgment or patient perception.

1.8.7 Patients' satisfaction score

It is a consumer experience metric that represents the satisfaction levels of patients with the overall healthcare received. Patients' ratings their overall satisfaction with treatment outcomes using the quartile grading scale:

1 = Very dissatisfied

2 = Dissatisfied

3 = Neutral

4 = Satisfied

5 = Very satisfied



CHAPTER 2

LITERATURE REVIEW

2.1 Structure of the Skin

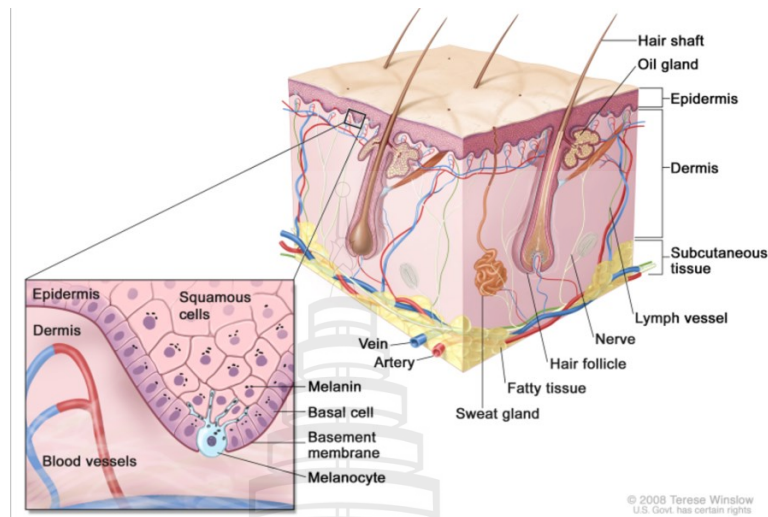
The skin is also known as the largest organ of the body which is about 20 square feet (15). It is made up of three layers, the epidermis, dermis and the hypodermis, all three of which vary significantly in their anatomy and function. The upper layer is the epidermis, the layer below epidermis is the dermis, and deepest layer is the subcutaneous tissue.

1. The epidermis, the outermost layer of skin, provides a waterproof barrier and contributes to skin tone.
2. The dermis, found beneath the epidermis, contains connective tissue, hair follicles, blood vessels, lymphatic vessels and sweat glands.
3. The deeper subcutaneous tissue (hypodermis) is made of fat and connective tissue.

The functions of the skin include:

1. Protection against microorganisms, dehydration, ultraviolet light, and mechanical damage; the skin is the first physical barrier that human body has against the external environment.
2. Sensation of pain, temperature, touch and deep pressure starts with the skin.
3. Mobility which allows smooth movement of the body.
4. Endocrine activity like vitamin D production which is essential for calcium absorption and normal bone metabolism
5. Exocrine activity like production of sebum, sweat and pheromones as well as exertion of immunologic functions by secreting bioactive substances such as cytokines
6. Immunity development against pathogens

Regulation of Temperature by conserving or releasing heat and helps to maintain the body's water and homeostatic balance (16).



Source (17)

Figure 2.1 Normal Structure of Skin

2.2 What is Acne-induced Post Inflammatory Erythema?

Acne-induced post inflammatory erythema, also referred to as post-inflammatory erythema (PIE), is a prevalent concern in dermatology, particularly among individuals with a history of acne. This condition refers as persistent redness or discoloration in areas previously affected by inflammatory lesions, which may exist for weeks to months after the resolution of active acne (1-2).

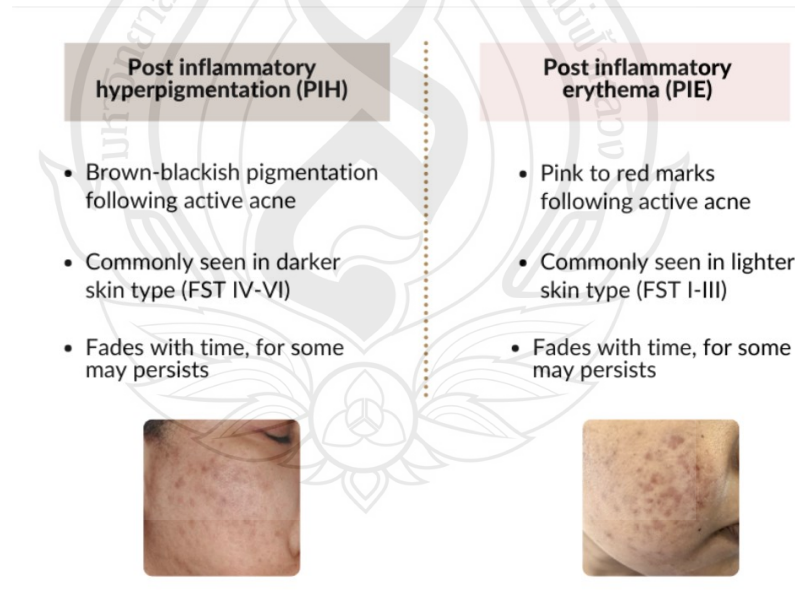
Pathogenesis of acne is caused by four factors;

1. Sebum production
2. Abnormal desquamation of keratinocytes
3. Presence of *Propionibacterium*
4. Inflammation

Inflammatory acne is characterized by erythematous papules, pustules (less than 5mm) and nodules (more than 5mm) (18). PIE arises from the complex interplay of inflammatory mediators, including cytokines and prostaglandins, which contribute to vasodilation and increased blood flow in the dermis, resulting in erythema. Dilatation of blood vessels are part of skin's the skin's normal healing process as a response to

dermal injury, designed to provide oxygen, chemical factors and nutrients necessary for the skin to recover from the injury (1).

While PIE is not physically harmful, it can thoroughly impact patients' psychological well-being, leading to feelings of self-consciousness and decreased quality of life, especially when the condition proves resistant to treatment (2). Many people who have experienced acne not only struggle with the aftereffects of scarring but also encounter post-inflammatory dyspigmentation which often presents as hyperpigmentation (PIH). However, in people with lighter skin types (Fitzpatrick skin types I-III), detach erythematous macules are more common than hyperpigmentation. Both PIE and PIH tends to resolve over time, thus differing from a true scar that persists. Sometimes, patients will have any combination of PIH, PIE and true scars. Post-inflammatory erythema (PIE) is common following inflammatory acne and its persistence can be cosmetically distressing. Acne may not be the only cause of post-inflammatory erythema, as any resolving cutaneous inflammatory process may have residual erythema. In contrast, erythematotelangiectatic rosacea is a separate diagnosis as the redness of rosacea is not part of a resolving process (2).



Source (19)

Figure 2.2 Comparison of PIH and PIE

2.3 Pathophysiology of PIE

Post-inflammatory erythema (PIE) develops as a result of the inflammatory response with the skin triggered by various conditions such as acne, eczema or dermatitis. The initial phase of inflammation involves the release of pro-inflammatory cytokines such as interleukin-1(IL-1), interleukin-6(IL-6) and tumor necrosis factor-alpha (TNF- α). These cytokines induce vasodilation and increased vascular permeability, leading to the infiltration of immune cells into the affected area (1). Neutrophils and macrophages are between the key immune cells recruited to the site of injury where they release additional inflammatory mediators and engage in phagocytosis to eliminate pathogens and cellular debris. The prolonged presence of inflammatory signals and immune cell infiltration preserve vascular dilation, especially in the capillaries, resulting in persistent (2).

Furthermore, the chronic inflammation associated with PIE disrupts normal skin physiology, leading to alterations in skin texture and pigmentation. Inflammatory mediators and reactive oxygen species (ROS) released during inflammation contribute to tissue damage and remodeling, further exacerbating erythema (1). ROS induce oxidative stress in skin cells, leading to lipid peroxidation, protein damage and DNA mutations which can impair cellular function and worsen inflammation.

2.4 Changes of Skin in PIE

Additionally, PIE is characterized by alterations in skin texture and pigmentation. Chronic inflammation deranges the normal turnover of skin cells and extracellular matrix components, contributing to changes in skin textures such as roughness or unevenness (1). The impairment of collagen and elastin leads to the loss of skin elasticity and firmness observed in PIE. Moreover, the deposition of melanin, the pigment responsible for skin color, can be altered in response to inflammation, contributing to hyperpigmentation or hypopigmentation in affected areas. These pigmentary changes further lead to the visible discoloration and unevenness of the skin in patients with PIE.

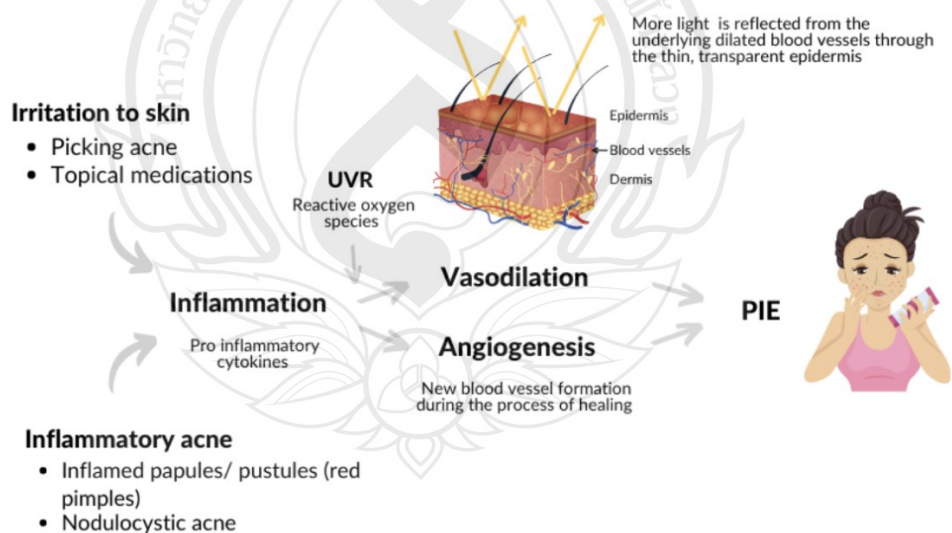
2.4.1 Types of Erythema: Erythema associated with post-acne lesions can be categorized into two main types:

1. Erythematous macules: These are flat, red patches of skin that remain after acne lesions heal. They result from persistent dilation of blood vessels in the affected area.

2. Erythematous Patches: These are similar to macules but may be slightly raised and have a more profound red appearance. They can take longer to fade and may be more resistant to treatment.

2.4.2 Risk Factors: Several factors can increase the risk of developing post-acne erythema, including:

1. Severe or prolonged acne inflammation
2. Delayed treatment of acne lesions
3. Skin type: Individuals with fair or sensitive skin are more prone to developing erythema
4. Genetic predisposition to post-inflammatory hyperpigmentation (PIH) or erythema



Source (19)

Figure 2.3 Mechanism of PIE

2.5 Current Treatment Options for PIE

Post-acne erythema, characterized by persistent redness following resolution of inflammatory acne lesions, poses significant challenge in dermatological practice due to its impact on patient satisfaction and quality of life (1). Current treatment modalities primarily aim to reduce erythema severity and promote skin healing.

2.5.1 Topical therapies: Azelaic acid and niacinamide have demonstrated efficacy in reducing erythema by targeting inflammation and improving skin barrier function. Chemical peels which involve the application of exfoliating agents such as glycolic acid or salicylic acid can also help improve skin tone and texture by promoting the shedding of dead skin cells.

Topical vitamin C derivatives such as isostearyl-L-ascorbic acid have demonstrated effectiveness in improving post-inflammatory erythema (9). Antioxidant serums such as silymarin have shown beneficial effects in acne-related inflammation (10).

Combination formulations containing retinol, niacinamide and ceramides have also shown improvements in acne and post-inflammatory skin conditions (11).

Additionally, plant-based treatments such as broccoli stem extract cream have demonstrated beneficial effects on post-acne lesions (12).

2.5.2 Injectable treatments: Corticosteroids and hyaluronic acid (HA) have also been explored for their potential in reducing post-acne erythema. Intralesional corticosteroid injections target inflammation and vascular dilation, contributing to rapid reduction in erythema severity. On the other hand, HA injections offer a non-inflammatory approach to erythema management by providing hydration and promoting tissue repair. Despite clinical evidence supporting their efficacy in post-acne erythema is limited, HA fillers have shown promise in improving skin texture and overall appearance in acne scar patients. However, their use is limited by the risk of skin atrophy and telangiectasia, especially with repeated injections or high concentrations.

2.5.3 Laser and light-base therapies: These include Alexandrite lasers, pro-yellow lasers, pulse dye lasers (PDL), high-power optically pumped semiconductor laser (HOPSL), fractional photothermolysis Nd:YAG laser, erbium glass fractional

laser and intense pulse light (IPL) therapy. These lasers have gained popularity for their ability to target vascular and pigmented lesions associated with post-inflammatory erythema (21). Among these modalities, pulsed dye laser (PDL) is considered a gold standard due to its selective targeting of hemoglobin (4).

2.6 Information about Pulse Dye Laser (PDL)

Pulse dye laser (PDL) therapy is a well-established treatment modality for various dermatological conditions, including post-inflammatory erythema (PIE). PDL emits pulses of yellow light at a wavelength of 585 to 595 nanometers, selectively targeting hemoglobin within blood vessels in the skin (4).

Mechanism of action of PDL:

1. Targeting chromophores: When the PDL light is directed onto the skin, the hemoglobin within the targeted blood vessels absorbs the energy from the laser. This absorption causes the hemoglobin to heat up rapidly.
2. Thermal damage: Rapid heating of the hemoglobin leads to thermal damage to the blood vessels. This damage causes coagulation of the blood within the vessels and subsequent destruction of the vessel walls.
3. Vessel Clearance: Following treatment, the body's natural healing processes clear away the coagulated blood and damaged vessel structures. Over time, the treated blood vessels are absorbed by the body, resulting in the disappearance of the vascular lesion.
4. Selective Photothermolysis: The key principle underlying the effectiveness of PDL treatment is selective photothermolysis. This is called as the ability of the laser to selectively target a specific chromophore while sparing surrounding tissues with different optical properties (3).

Clinical studies have demonstrated significant improvement in acne erythema following PDL treatment (6).

Comparative studies have shown effectiveness of PDL compared with other laser modalities (5).

PDL has also been shown to be effective in vascular lesions and scar treatment in Asian populations (20).

Additionally, PDL has demonstrated anti-inflammatory effects in acne patients (21).

2.7 Information About Dragon's Blood Serum

In recent years, natural remedies and botanical extracts have gained attention in dermatological practice for their anti-inflammatory, antioxidant and wound-healing properties (13). Among these, Dragon's Blood which is a resin obtained from the *Croton lechleri* tree, has come out as a potential therapeutic agent for various skin conditions including post-inflammatory erythema (PIE). The resin contains a complex mixture of bioactive compounds, including phenolic compounds, flavonoids, proanthocyanidins and alkaloids which add to its pharmacological activities (22).

2.7.1 Anti-inflammatory properties: Many studies have demonstrated that Dragon's Blood inhibits pro-inflammatory cytokines such as tumor necrosis factor-alpha (TNF- α) and interleukin-1 beta (IL-1 β) and modulates inflammatory signaling pathways (13).

2.7.2 Anti-oxidant properties: DB exhibits antioxidant effects by scavenging free radicals and reducing oxidative stress-induced damage to skin cells (10). These effects contribute to the preservation of skin integrity and prevention of premature aging signs, making DB a promising ingredient in skincare formulations for dermatological conditions, including PIE.

2.7.3 Wound-healing properties: Studies have shown that DB accelerates wound healing process by stimulating the proliferation of fibroblasts, enhancing collagen synthesis and promoting angiogenesis (14).

These studies show that DB may alleviate erythema-associated skin conditions, improve skin barrier and speed up the resolution of erythematous lesions. What's more, DB has been contained into various skincare products such as serums, creams and masks highlighting its growing popularity as a natural remedy for skin disorders.

2.8 Comparative Analysis

While many studies have investigated the efficacy of PDL and DBS individually for inflammatory skin disorders, there is not any study which compares directly these two treatments for PIE. Comparative studies are essential for determining the relative effectiveness and safety of different modalities and advising clinical decision-making. Therefore, there is a need for well-designed comparative studies to evaluate the efficacy, safety and long-term outcomes of PDL versus DBS for PIE. When comparing PDL therapy and Dragon's Blood serum for the treatment of PIE, the following factors will be considered:

2.8.1 Efficacy: Both modalities have shown efficacy in reducing erythema and improving skin texture through different mechanisms of action.

2.8.2 Safety: PDL therapy is generally considered safe with minimal risk of adverse effects. DB being a natural product might have fewer side effects but requires careful formulation and quality control.

2.8.3 Patient preferences: Some patients may prefer non-invasive topical treatments like DB over laser therapy due to comfort and convenience.

2.9 Conclusion

In conclusion, both PDL therapy and DB can show effective results in the treatment of PIE. PDL therapy offers targeted, effective results but require multiple sessions and carry a higher cost. Dragon's Blood serum might provide a natural alternative of anti-inflammatory benefits but is only less extensively studied. In the end, treatment decisions have to be based on efficacy, safety, severity of erythema and patient satisfactions.

CHAPTER 3

RESEARCH METHODOLOGY AND EQUIPMENTS

3.1 Study Design

The study design for this research is a randomized, split-faced experimental trial which allows for direct comparison of two interventions on the same patient. The split-faced design also enables the assessment of both interventions within the same participant, reducing inter-person variability and improving the study's internal validity.

3.2 Study Population

Asian patients, ages 18-45 years old, Fitzpatrick skin types III-IV with acne-induced post inflammatory erythema.

3.3 Sample

Both male and female volunteers, ages 18-45 years old, skin types III-IV with acne-induced post inflammatory erythema on both sides of cheeks who want to get treated. They will be explained about each step of the study and requested their written consent for participation in the study before the study is started.

3.4 Sample Size

The sample size is calculated from the formula of one sample, using the ration of measurement from the previous study (23).

Different change from baseline of PRP treated side (μ_1)

$$= 12.47 - 5.11$$

$$= 7.36$$

Different change from baseline of Nd:YAG laser treated side (μ_2)

$$= 11.27 - 5$$

$$= 6.27$$

Set $\alpha = 0.05$ (two-tailed) $Z_{\alpha/2} = 1.96$

Set $\beta = 0.2$ $Z_{\beta} = 0.842$

$$S_1 = 1.24, S_2 = 1.1$$

$$n_1 = 30, n_2 = 30$$

$$S_p^2 = \frac{S_1^2(n_1-1) + S_2^2(n_2-1)}{(n_1+n_2)-2}$$

$$= 1.3738$$

$$n = \frac{(Z_{\alpha/2} + Z_{\beta})^2 \times S_p^2}{(\mu_1 - \mu_2)^2}$$

$$= \frac{(1.96 + 0.842)^2 \times 1.3738}{(7.36 - 6.27)^2}$$

$$= 9.065 \approx 9$$

Expected dropout rate is 20%, $n = 9 + 2 = 11$

So, total participants ($n=11$) will be recruited.

3.5 Selection Criteria

3.5.1 Inclusion Criteria

3.5.1.1 Male and female participants of age 18 to 45 years old who have persistent post-acne erythema on both sides of their face (Fitzpatrick skin types III-IV)

3.5.1.2 Volunteers who were willing to accept PDL therapy and DB on each side of face.

3.5.1.3 Volunteers who have completed any previous treatment for acne at least 3 months prior to enrollment.

3.5.1.4 Volunteers who accepted to avoid other facial treatments including laser during the study.

3.5.1.5 Volunteers who understand every step of the research and follow according to the research protocols.

3.5.1.6 Volunteers who gave consent to participate throughout study period.

3.5.2 Exclusion Criteria

3.5.2.1 Volunteers who was pregnant or gave lactation.

3.5.2.2 Volunteers who had allergy to Dragon's Blood Serum.

3.5.2.3 Volunteers with history of keloid formation or hypertrophic scarring.

3.5.2.4 Volunteers with history of systemic diseases or medications that could affect skin healing or erythema severity.

3.5.2.5 Volunteers who received laser or light-based therapies or previous 3 months.

3.5.2.6 Volunteers with medical or psychiatric problems that is severe enough to interfere with the study results (researcher's opinion).

3.5.2.7 Used of isotretinoin, hormones, prednisolone, antiplatelet and anticoagulant withing 6months and NSAIDS within one week before study.

3.5.3 Discontinuation criteria

3.5.3.1 Volunteers who want to discontinue the program due to any reason.

3.5.3.2 Volunteers who encounter serious adverse effects from the treatment.

3.5.3.3 Serious illness and extensive medications

3.5.3.4 Failure in follow up appointments

3.6 Study location

Mae Fah Luang University Hospital, Bangkok

3.7 Interventions

Half of the patient's face will be treated with the pulsed dye laser (V-beam Pecfecta laser R; Candela Laser Corporation, Wayland, MA, USA) and another half with Dragon's Blood Serum.

3.7.1 Pulsed dye laser: 595 nm

Laser treatment will be performed on the half side of the face using the following parameters: 595nm, non-overlapping single pulses, pulse duration 10ms, spot size 7mm with fluence range 7-9 J/cm² adjustment according to skin types.



Source (24)

Figure 3.1 Vbeam Pulsed Dye Laser (PDL) Machine /Candela Brand

3.7.2 Dragon's Blood Serum is the Facial Serum which contains *Croton lechleri* Extract in Standard Serum Base

Dragon's Blood serum is composed mainly with red wood rubber extract of *Croton lechleri* extract which has been imported from amazon and other moisturizing ingredients. All ingredients are Grade A and they are safe for application on the face.



Figure 3.2 30ml Tube of Dragon's Blood Facial Serum Approved by Thai FDA

The ingredients of DBS are listed as shown in the following in (Table 3.1)

Table 3.1 Ingredients of Dragon's Blood Facial Serum

INCI Name	Function
Deionized water	Solvent
Disodium EDTA	Skin conditioning
Acrylates	Thickener
Deionized water	Solvent
Triethanolamine	pH adjustor
Glycerin	Humectant
Xanthan Gum	Thickener
Propanediol	Skin conditioning
Water	Skin conditioning
Croton lechleri Resin Powder	Skin conditioning
Phenoxyethanol	Preservative
Chlorphenesin	Preservative
Glycerin	Preservative

3.8 Measurement Equipments and Parameters

3.8.1 VISIA Scan

VISIA ® Complexion Analysis System is an equipment used for scanning the condition of facial skin. It uses multi-spectral imaging and analysis system to capture key visual information. It is used to measure the eight parameters of skin's healthiness and appearance, UV spots, photo damage, pigmentation, pore size, porphyrins (evidence of bacteria), texture and wrinkles under the same environment.



Source (25)

Figure 3.3 VISIA ® Skin Complexion Analysis System

3.8.2 Mexameter

The Mexameter MX18 is the device which determines precisely the content of melanin and erythema (caused by hemoglobin). The measurement is based on absorption or reflection.

For erythema measurement two specific wavelengths are used (green: 568nm and red: 660nm), corresponding to the spectral absorption peak of hemoglobin and to avoid other color influences (e.g. bilirubin).



Source (26)

Figure 3.4 Mexameter ® MX 18

3.8.3 Parameter of the treatment with pulsed dye laser; 595 nm Device

Treatments will be performed using the following parameters: wavelength 595nm, overlapping single pulses, spot size 7mm, pulse duration 10ms and fluence 7-9 J/cm² x 1 pass (Fluence levels are determined by patient's pain tolerance and condition severity such as a higher fluence is used for more severe erythema). All patients get treated total 3 sessions of 4 weeks intervals.

3.8.4 Parameter of the treatment with Dragon's Blood Serum

The participants will be tested with patch test before applying the Dragon's Blood Serum. The serum will be applied on the arms of the volunteers under waterproof patch test and wait for one day. The volunteers are required to avoid doing strenuous exercises, prolong exposure to daylight within 24hr trial and are observed for any effects after 48 and 96 hrs. Any effects that occurred is documented according to the international contact dermatitis research group system as follow:

+? = any doubtful reaction for example only mild redness

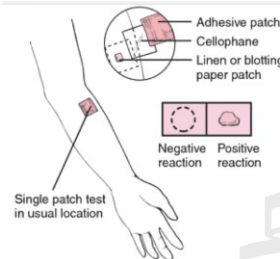
+ = weak positive reaction: the skin become erythematous and slightly thickened

++ = strong positive reaction: when the skin appeared erythematous edematous skin with small water blister

+++ = extreme positive reaction: when the skin appeared excessive erythema (redness) and large area of swelling with merged spreading or large blisters

If the erythematous skin is improved or disappeared following removal of the patch, the affected volunteer is assumed to have irritant reaction and would be excluded from the study.

If there is volunteer with positive patch test from score++, he or she would be excluded.



-	negative
?+	doubtful
+	faint macular, erythema only weak (non-vesicular) positive
++	Strong (vesicular) positive erythema, infiltration, possibly papules
+++	extreme positive bullous reaction erythema, infiltration, papules, vesicles
R+	Irritant Reaction of different types Ring reaction

- Kept 24 hrs
- Read 48-96 hrs
- Avoid excessive sweating & heavy sunlight

Source (27)

Figure 3.5 Patch Test Procedure

3.9 Steps of Research

3.9.1 Generate Randomization sequence

The researcher will be generated randomization sequence which randomly determined which side of the patient's face to be treated with pulsed dye laser and which side with Dragon's Blood Serum. By using "Random Allocation Software" and conceals the sequence in opaque envelopes.

3.9.2 Preparation of Research Subjects

3.9.2.1 The volunteers will be extensively explained about the purpose and steps of research and are obtained consent for participation in the study procedures.

3.9.2.2 The documents such as history taking, consent form, data assess and record documents will be taken from the participants.

3.9.2.3 The researcher will select the randomization sequence envelop.

3.9.3 Treatment process

3.9.3.1 Before each treatment, the patients' faces will be photographed using VISIA® Complexion Analysis System (Canfield, Fairfield, NJ) of which the following are required:

1. 12megapixel resolution
2. Automatic focus
3. Automated white balance correction
4. Captured facial positions: Left 33degree, Center 0 degree, Right 33 degree
5. Multi-spectral Imaging (standard daylight fluorescent lighting, cross Polarized and UV lighting)

3.9.3.2 Before treatment, the researcher will evaluate the erythema indexes of each patient using Mexameter MX18® (Courage+ Khazaka Electronic GmbH, Ko In, Germany). The erythema index is going to be measured on cheek, chin and forehead. The measurement is based on absorption or reflection. The probe emits 3 specific light wavelengths. A receiver measures the reflection from the skin. As the quantity of emitted light is defined, the quantity of light absorbed by the skin can be calculated. For the erythema measurement 2 specific wavelengths are used (green: 568 nm and red: 660nm), corresponding to the spectral absorption peak of hemoglobin and to avoid other color influence. It is worldwide established and used in many scientific studies.

3.9.3.3 Before the laser treatment, the treatment areas will be cleansed with a mild soap. Both eyes of the participant are covered with goggles to prevent radiation effect.

3.9.3.4 The researcher will do the intervention on one side of the patient's cheek according to the prepared randomized sequence. The laser treatment will be done once a month for three months consecutively at the hospital.

3.9.3.5 After the treatment, cold compression will be applied to relieve the patient's burning sensation. Patients will be advised to avoid sun exposure for at least 1-2 weeks after treatment and applied sunscreen every day.

3.9.3.6 Dragon's Blood Serum treatment protocol at home

1. Cleanse the face with a gentle, non-abrasive cleanser.
2. Dry the face by gently patting with a dry, clean tissue or towel.
3. Take a small amount of DBS by the fingertips and gently apply onto half side of face, focusing on the areas of erythema.
4. Apply the serum only targeted half side of face twice daily at night as part of regular skincare routine for total 9 weeks.

Block Randomization
Comparative, Split-faced Design

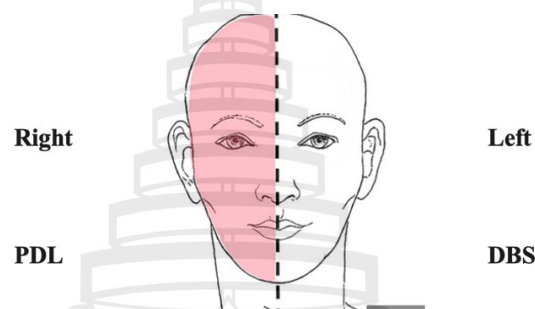


Figure 3.6 Right Face is Treated with PDL and Left Face is Treated with DBS

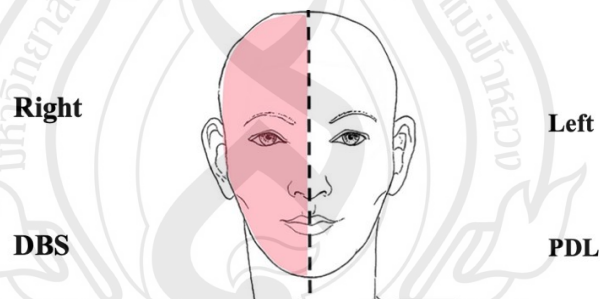


Figure 3.7 Right Face is Treated with DBS and Left Face is Treated with PDL

3.9.4 Follow up

At 3th, 6th and 9th weeks of study period, each patient's face will be recorded using VISIA®Complexion Analysis System. Erythema Index will be determined by Mexameter® on three selected postinflammatory erythema lesions same as baseline.

3.10 Outcome Measurement & Data collection

3.10.1 Primary Outcome Measure

For clinical evaluation of post inflammatory erythema, erythema scores obtained from Mexameter ® will be compared. We will measure erythema index on three selected erythema lesions at each of three visits and then calculated the average erythema index.

3.10.2 Secondary Outcome Measures

3.10.2.1 GAIS Scores will be assessed by two dermatologists and compared the results at 3rd, 6th and 9th week. Compare the mean of GAIS scores of the side of face treated with pulse dye laser:595nm with the mean of another side treated with dragon's blood serum after each treatment. Wilcoxon Signed-Rank test will be used to analyze possible differences.

3.10.2.2 Patient Assessments: We will ask the participants to evaluate their satisfaction with the treatments at the end of the study, rating their overall satisfaction with treatment outcomes using the quartile grading scale:

- 1 = Very dissatisfied
- 2 = Dissatisfied
- 3 = Neutral
- 4 = Satisfied
- 5 = Very satisfied

3.11 Data Analysis

Significance levels for all analyses are set at $p\text{-value} < 0.05$

3.11.1 Effectiveness as Evaluated by Dermatologists

The researcher will do the following:

3.11.1.1 To analyze non-parametric repeated measures of erythema index scores over multiple timepoints (baseline, week 3, week 6 and week 9), Friedman test will be used to compare mean of erythema index scores between two treatments.

3.11.1.2 Wilcoxon Signed-Rank test will be use to compare the data of GAIS scores from two treatments at each time point.

3.11.2 Patient Assessments

McNemar test will be used to compare the data of the satisfaction scores from the side of face treated with the pulsed dye laser: 595 nm device with the mean of another side treated with Dragon's Blood Serum.

3.12 Ethical Considerations

The study was strictly followed Good Clinical Practice (GCP) guidelines, an international ethical and scientific quality standard for designing, conducting, recording and reporting trials that involve the participation of human subjects, provided by International Conference on Harmonization (ICH).

Good Clinical Practice guidelines include protection of human rights as a subject in clinical trial, assurance of the safety and efficacy of the newly developed compounds, standards no how clinical trials should be conducted; define the roles and responsibilities of clinical trial sponsors, clinical research investigators and monitors. For general understanding, considerations were as followed.

3.12.1 Volunteers completely understand the objective, methodology and possible adverse effect of the research.

3.12.2 Volunteers are willing to sign informed consent before conducting the study. They can leave anytime without disadvantage.

3.12.3 This research is free of charge. There is no interest between the researcher and subjects.

3.12.4 Dragon's Blood Serum is approved by Thai FDA.
Patch test is done before study to prevent from allergy and hypersensitivity reaction.

3.12.5 In any case, if the problem occurs, the researcher will help and take responsibility with subjects as much as possible.

3.12.6 All volunteers' information is highly confidential

CHAPTER 4

RESULTS

4.1 Participant Characteristics

A total of 11 participants were initially recruited for this study. Total 11 Asian patients, 3 men and 8 women with post inflammatory erythema on both sides of cheeks were enrolled in the study. None of the patients were excluded through study.

The demographic characteristics of the participants, including age distribution, occupation, and Fitzpatrick skin type, are summarized below.

4.1.1 Age Distribution

The mean age of the participants was 31.55 ± 5.6 years. Among the participants, 6 individuals were aged between 20–30 years, while 5 participants were aged between 31–41 years.

Table 4.1 Age Distribution of Participants (n=11)

Age Group	Frequency
20-30 yrs	6
31-41 yrs	5
Mean $\pm$ SD	31.55 $\pm$ 5.6

4.1.2 Occupation of Participants

Regarding occupation, 6 participants were students, while 5 participants were employees.

Table 4.2 Occupation of Participants (n=11)

Occupation	Frequency
Employee	5
Student	6

4.1.3 Fitzpatrick Skin Type

Participants were categorized according to Fitzpatrick skin type. Among them, 6 participants had skin type III, while 5 participants had skin type II.

Table 4.3 Distribution of Fitzpatrick Skin Types (n=11)

Skin Type	Frequency
II	5
III	6

4.2 Changes in Erythema Index Scores

The erythema index was measured using the Mexameter MX18 at four time points:

1. Baseline (before treatment)
2. Week 3
3. Week 6
4. Week 9

The mean erythema index scores for both Pulsed Dye Laser (PDL) and Dragon's Blood Serum (DBS) treatment sides are presented in Table 4.4.

Table 4.4 Comparison of Mean and Standard Deviation of Erythema Index between Two Treatments (n=11)

Mean Erythema Index Score	Laser Treatment		Dragon's Blood Serum Treatment		p-value
	mean	SD	mean	SD	
Before Treatment	441.45	69.72	431.36	62.29	0.387
3 Week after Treatment	413.91	71.63	425	51.37	0.47
6 Week after Treatment	389.45	66.52	421	54.28	0.014
9 Week after Treatment	354.27	47.97	392.88	39.4	0.003
Repeated measurement	F=22.86		F= 4.082		
ANOVA	p < 0.0001		p=0.015		

Note Repeated-measures ANOVA demonstrated:

Laser treatment: F = 22.86, p < 0.0001

Serum treatment: F = 4.082, p = 0.015

These results indicate that both treatments significantly reduced erythema index over time, with a greater reduction observed on the laser-treated side.

Table 4.5 Reduction of Mean Erythema Index Score Before Treatment and After each Treatment Session (n=11)

Groups of comparison	mean erythema index score		
	Paired difference	SD	P-value
Laser Treatment			
Before treatment-3 rd week	27.54	26.34	0.006
Before treatment-6 th week	52.00	47.89	0.005
Before treatment-9 th week	87.18	40.47	<0.0001
Dragon's Blood Serum Treatment			
Before treatment-3 rd week	6.36	31.06	0.512
Before treatment-6 th week	10.36	32.99	0.322
Before treatment-9 th week	38.47	44.6	0.017

Note paired t-test

4.3 Comparison of Erythema Index Between Treatments

The differences in erythema index scores between the two treatments were analyzed using paired t-tests.

Table 4.6 Comparison of Mean Erythema Index Scores Between Treatments (n=11)

(laser Treatment - Serum Treatment)	Mean Erythema Index		
	Paired difference	SD	P-value
Before Treatment	10.091	37.015	0.387
3 rd week	-11.091	49.013	0.47
6 th week	-31.545	35.365	0.014
9 th week	-38.62	33.32	0.003

The results indicate:

1. No significant difference at baseline and week 3
2. Significant differences at week 6 and week 9

This demonstrates that PDL treatment resulted in greater improvement in erythema compared with Dragon's Blood Serum after multiple treatment sessions.

4.4 Changes in Global Aesthetic Improvement Scale (GAIS)

Clinical improvement was evaluated using the Global Aesthetic Improvement Scale (GAIS) by dermatologists at weeks 3, 6, and 9.

Table 4.7 GAIS Score Before Treatment and After each Follow Up Treatment Session (n=11)

GAIS score	Laser Treatment		Dragon's Blood Serum Treatment		p-value
	mean	SD	mean	SD	
Week 3	2.55	0.688	1.91	0.53	0.112
Week 6	3.00	0.894	2.18	0.405	0.03
Week 9	4.18	0.603	3	0.894	0.016
Friedman Test	p < 0.0001		p=0.003		

Friedman test results:

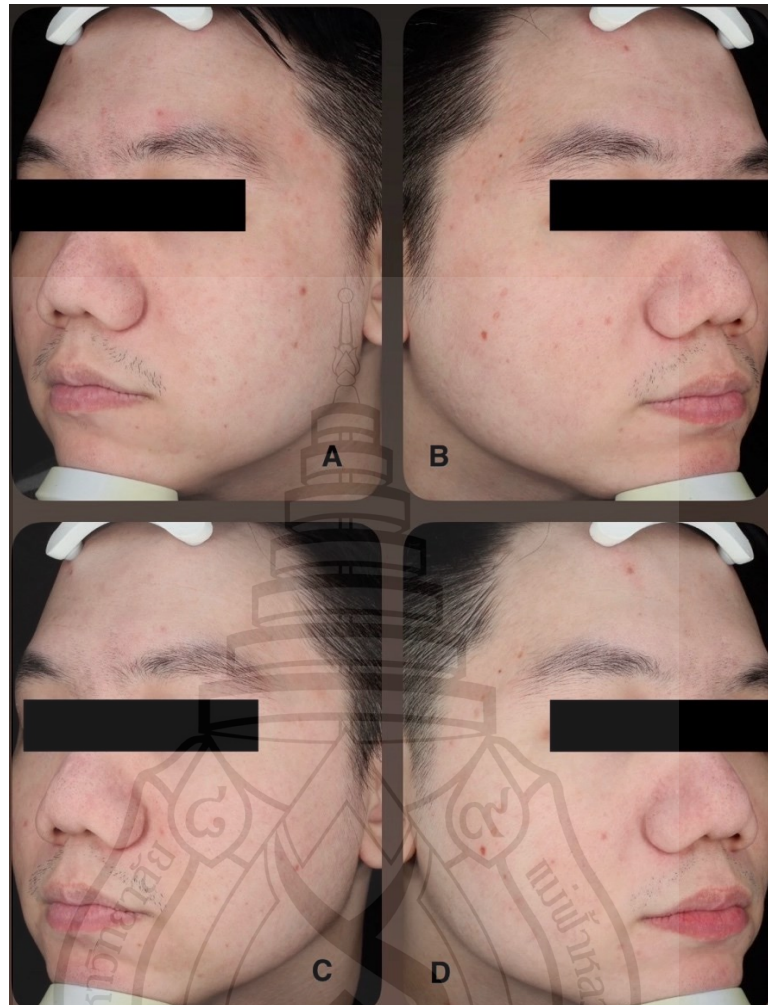
Laser side: p < 0.0001

Serum side: p = 0.003

Table 4.8 Comparison of GAIS Score between Treatments

Groups of comparison	mean GIAS score		
	Paired difference	SE	P-value
Laser Treatment			
6 th week-3 rd week	0.455	0.207	0.159
9 th week-3 rd week	1.636	0.203	<0.0001
9 th week-6 th week	1.182	0.226	0.001
Dragon's Blood Serum Treatment			
6 th week-3 rd week	0.273	0.195	0.576
9 th week-3 rd week	1.091	0.285	0.010
9 th week-6 th week	0.818	0.226	0.014

Note Multiple comparisons: Bonferroni



Note (A) Base line, (C) Week 9 after 3 treatment sessions of pulsed dye laser: 595nm device. (B) Baseline, (D) Week 9 after twice daily application of Dragon's Blood Serum

Figure 4.1 Patient with Acne-induced Post Inflammatory Erythema on Both Sides of The Face

4.5 Patient Satisfactory Score

Patient satisfaction was assessed at week 9 using a 5-point scale.

To compare patient satisfaction between the two treatments, McNemar–Bowker test was applied.

Table 4.9 Cross-tabulation of Satisfaction Scores at Week 9 (n=11)

Satisfaction Scores by volunteers at 9th week	PDL side	DBS side
3	4	6
4-5	7	5

Note P-value = 0.305

McNemar test= 0.687

This indicates that there was no statistically significant difference in satisfaction scores between the two treatments.

However, the laser-treated side demonstrated a higher proportion of very satisfied patients compared with the serum-treated side.

4.6 Summary of Findings

The key findings of this study are summarized as follows:

1. Both Pulsed Dye Laser (595 nm) and Dragon's Blood Serum significantly reduced erythema index over the 9-week treatment period.
2. Laser treatment produced a greater reduction in erythema index, with statistically significant differences observed at week 6 and week 9.
3. GAIS scores showed significant clinical improvement in both treatments, although laser treatment demonstrated superior outcomes.
4. Patient satisfaction scores were higher for the laser-treated side, but the difference between treatments was not statistically significant based on McNemar–Bowker test.

Overall, these findings suggest that Pulsed Dye Laser provides greater clinical improvement in acne-induced post-inflammatory erythema compared with Dragon's Blood Serum.

CHAPTER 5

DICUSSION AND CONCLUSION

5.1 Overview of Findings

Post-inflammatory erythema (PIE) is a common sequela of inflammatory acne characterized by persistent erythematous macules resulting from dermal vascular dilation and inflammation Post-inflammatory erythema. Although PIE may resolve spontaneously, the process can take several months to years, often leading to cosmetic concerns and psychological distress among affected individuals (1-2).

The present study aimed to compare the effectiveness of pulsed dye laser (PDL) and Dragon's Blood serum (DBS) in the treatment of acne-induced PIE. Objective assessment was performed using erythema index measurements obtained via Mexameter MX18 at baseline, week 3, week 6, and week 9. In addition, subjective outcomes including Global Aesthetic Improvement Scale (GAIS) and patient satisfaction were evaluated.

The findings demonstrated that both treatment modalities resulted in improvement over time. However, PDL showed significantly greater and earlier reduction in erythema index scores compared with DBS, particularly during the early treatment phases. These findings are consistent with previous literature supporting vascular-targeted laser therapy as an effective modality for erythematous skin conditions (1, 3, 5).

5.2 Effectiveness of Pulsed Dye Laser on Post-inflammatory Erythema

The results presented in Chapter 4 demonstrated that PDL significantly reduced erythema index scores at all follow-up intervals.

At week 3, a statistically significant reduction was observed (mean paired difference: 27.54 ± 26.34 ; $p = 0.006$), indicating early therapeutic efficacy. This rapid response may be attributed to the direct targeting of dermal vasculature.

At week 6, further improvement was noted (52 ± 47.89 ; $p = 0.005$), suggesting a sustained treatment effect. By week 9, the reduction was most pronounced (87.18 ± 40.47 ; $p < 0.0001$), reflecting a cumulative benefit of repeated laser sessions.

The effectiveness of PDL can be explained by the principle of selective photothermolysis, in which specific wavelengths (585–595 nm) selectively target oxyhemoglobin within dermal blood vessels, leading to vascular coagulation without significant damage to surrounding tissues (4, 6). This mechanism directly addresses the vascular component of PIE.

These findings are consistent with previous studies. For example, Firas Al-Niaimi and Chiang reported that PDL is one of the most effective vascular lasers for erythematous dermatologic conditions (8). Similarly, Gabriele Fabbrocini et al. demonstrated significant improvement in erythematous acne scars following vascular laser therapy (5). Additionally, Levy et al. reported that laser therapy may reduce inflammatory mediators, further contributing to clinical improvement (1).

5.3 Effectiveness of Dragon's Blood Serum on Post-inflammatory Erythema

In the DBS-treated group, erythema index scores improved over time; however, the magnitude and rate of improvement were lower compared with PDL.

At week 3 ($p = 0.512$) and week 6 ($p = 0.322$), reductions were not statistically significant. Significant improvement was observed only at week 9 (38.47 ± 44.6 ; $p = 0.017$), indicating a delayed therapeutic effect.

Dragon's Blood, derived from *Croton lechleri*, contains bioactive compounds such as proanthocyanidins and phenolic compounds, which exhibit anti-inflammatory and antioxidant properties (13-14). These compounds may inhibit pro-inflammatory cytokines and promote wound healing, thereby contributing to gradual reduction of erythema (13).

The delayed response observed in this study may be explained by its topical mechanism of action, which primarily targets inflammation and tissue repair rather than vascular dilation. Previous pharmacological studies have similarly reported its efficacy in enhancing wound healing and reducing inflammation (13-14).

5.4 Comparison Between Pulsed Dye Laser and Dragon's Blood Serum

When comparing both modalities, PDL demonstrated more rapid and greater improvement in erythema index scores than DBS.

PDL produced statistically significant improvement as early as week 3, whereas DBS required 9 weeks to achieve significance. This difference can be attributed to the direct vascular targeting of laser therapy versus the indirect anti-inflammatory mechanism of topical treatment.

These findings are consistent with previous studies highlighting PDL as an effective treatment for vascular skin conditions (5-6). Wang and Manstein also emphasized that PDL selectively targets hemoglobin, making it highly effective for vascular lesions (3).

Therefore, the present study supports the hypothesis that PDL provides superior clinical outcomes compared with DBS in treating acne-induced PIE.

5.5 Global Aesthetic Improvement Scale (GAIS)

GAIS assessment demonstrated greater overall improvement in the PDL-treated group compared with the DBS group.

A higher proportion of patients treated with PDL were categorized as “much improved” or “very much improved,” which aligns with the objective erythema index findings. The early and significant reduction in erythema observed with PDL likely contributed to higher GAIS scores.

Previous studies have similarly reported superior aesthetic outcomes with vascular laser therapy (1, 5). In contrast, DBS showed gradual improvement, reflecting its slower mechanism of action.

Despite lower GAIS scores, DBS still demonstrated clinical benefit and may serve as a non-invasive alternative for patients unable or unwilling to undergo laser treatment.

5.6 Patient Satisfaction Analysis

Patient satisfaction was higher on the PDL-treated side, consistent with the objective and GAIS findings.

This may be attributed to the faster and more visible results achieved with laser therapy. Previous studies have also reported high satisfaction rates with PDL due to its efficacy in reducing erythema (6).

However, DBS remains a favorable option for some patients due to its non-invasive nature, lower cost, and ease of use, which may improve treatment adherence.

5.7 Clinical Implications

The findings of this study suggest that:

1. PDL is a highly effective treatment for acne-induced PIE, providing rapid and significant improvement
2. DBS may serve as an adjunct or alternative treatment for patients preferring topical therapy
3. Treatment selection should consider patient preference, cost, and accessibility

5.8 Study Limitations

Several limitations should be acknowledged:

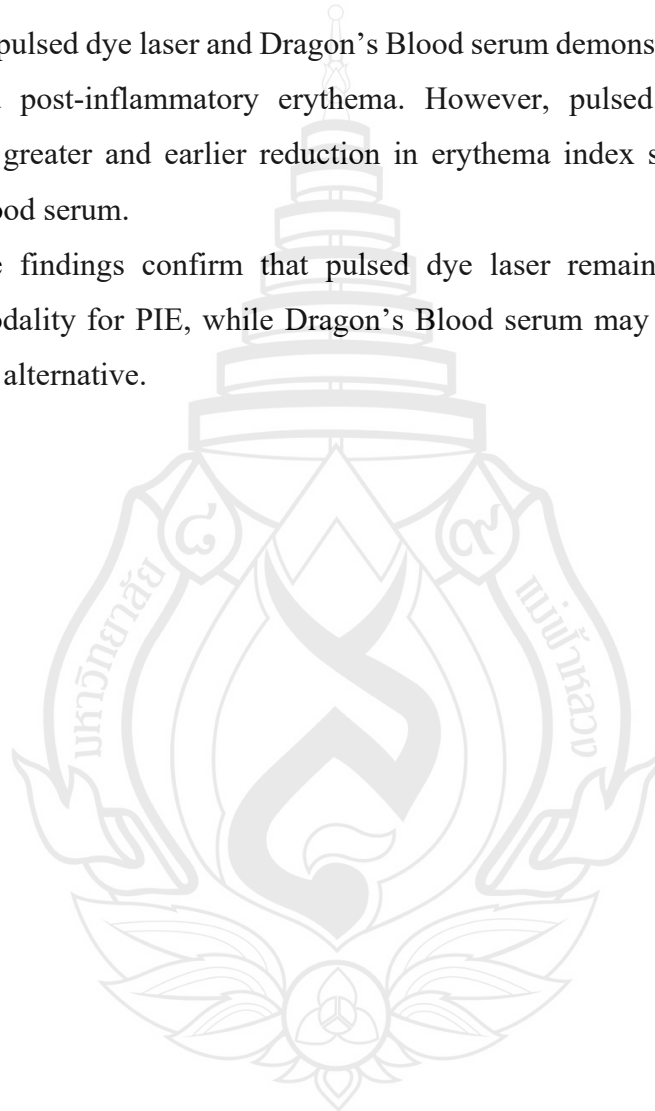
1. Small sample size, limiting generalizability
2. Short follow-up period (9 weeks), preventing long-term evaluation
3. Inclusion limited to Fitzpatrick skin types III–IV

Future studies with larger sample sizes and longer follow-up periods are recommended.

5.9 Conclusion

Both pulsed dye laser and Dragon's Blood serum demonstrated improvement in acne-induced post-inflammatory erythema. However, pulsed dye laser produced significantly greater and earlier reduction in erythema index scores compared with Dragon's Blood serum.

These findings confirm that pulsed dye laser remains the more effective treatment modality for PIE, while Dragon's Blood serum may serve as a supportive non-invasive alternative.



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APPENDIX A

INFORMED CONSENT FORM

Informed Consent Form

I, _____, have decided to participate in [**A Split-faced comparative study of Pulse dye laser:595nm and Dragon's blood serum for Acne-induced Post Inflammatory Erythema**]. I have received information and explanations about this research, and I have had the opportunity to ask questions and receive satisfactory answers. I have had sufficient time to read and understand the information provided in the documents thoroughly and have decided to participate in this research.

I understand that I have the freedom to choose not to participate in this research, and I can withdraw from this research at any time without any impact on my care or rights that I am entitled to.

By signing this document, I do not waive any rights that I am entitled to under the law, and after signing, I will receive a copy of the information sheet and the informed consent.

Participant's Signature _____ Date _____
()

..... (For illiterate participants who can understand though listening)

I cannot read, but the researcher has read this information sheet and informed consent form to me, and I understand it well. Therefore, I voluntarily sign or place my fingerprint.

Participant's signature/fingerprint _____ Date _____
()

Signature of the person requesting consent _____ Date _____
()

Testimony of a witness who is not a stakeholder in the research (If the participant cannot read but can understand through listening)

I have been present during the consent request process and confirm that the person requesting consent has read / explained the information sheet to _____. The aforementioned person had the opportunity to ask questions and decided to participate voluntarily after understanding the information in this document.

Witness's signature _____ Date _____
(_____)



APPENDIX B

RESEARCH PROFILE (CONFIDENTIAL)

DO NOT PUBLISH INFORMATION **RESEARCH PROFILE (CONFIDENTIAL)**

General Information

1. Name:.....
2. Email:
3. Address:
4. Gender:
5. Occupation:
6. Photosensitivity or drug-induced photosensitivity:
7. History of food or drugs allergy:
8. Facial skin conditions
 - Redness:
 - Scar or ulcers:
 - Active dermatological condition:
 - Others (specify):
9. Medical history
 - Active skin disease:
 - History of malignant or pre-malignant lesions:
 - Chemo-radiotherapy:
 - Other (specify):
10. Current skin care products use:
11. History of following treatments before study
 - Chemical peeling
 - Dermabrasion
 - Any light-based therapy or laser treatment
 - Any injectable treatments

- Topical or oral steroids
- Other (specify):

12. Gynaecology history (if female)

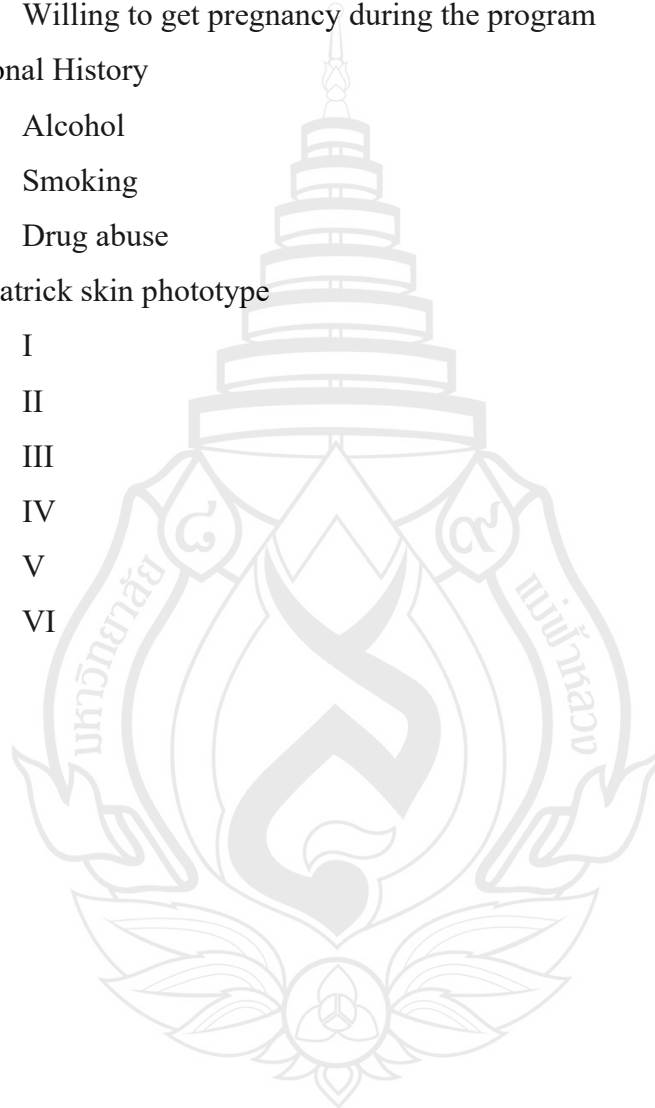
- Pregnancy
- Breastfeeding
- Willing to get pregnancy during the program

13. Personal History

- Alcohol
- Smoking
- Drug abuse

14. Fitzpatrick skin phototype

- I
- II
- III
- IV
- V
- VI



APPENDIX C

DOCTOR'S RECORD FORM

Study Title: Split-faced, comparative study of pulsed dye laser: 595nm and Dragon's Blood Serum for acne-induced post-inflammatory erythema (PIE)

Participant ID: _____

Date of Enrollment: _____

Section A: Erythema Index (Mexameter®)

Scoring:

0 = < 200 (None/ minimal)

1 = 200-299 (Mild)

2 = 300-399 (Moderate)

3 = 400- 499 (Marked)

4 = ≥ 500 (Severe)

Timepoint	PDL side reading	Score for PDL side (0-4)	DBS side reading	Score for DBS side (0-4)
Baseline		☐ 0 ☐ 1 ☐ 2 ☐ 3 ☐ 4		☐ 0 ☐ 1 ☐ 2 ☐ 3 ☐ 4
Week 3		☐ 0 ☐ 1 ☐ 2 ☐ 3 ☐ 4		☐ 0 ☐ 1 ☐ 2 ☐ 3 ☐ 4
Week 6		☐ 0 ☐ 1 ☐ 2 ☐ 3 ☐ 4		☐ 0 ☐ 1 ☐ 2 ☐ 3 ☐ 4
Week 9		☐ 0 ☐ 1 ☐ 2 ☐ 3 ☐ 4		☐ 0 ☐ 1 ☐ 2 ☐ 3 ☐ 4

Section B: GAIS (Co-Investigator Assessment)

Scale:

1 = Worse, 2 = No Change, 3 = Improved, 4 = Much Improved, 5 = Very Much

Improved

Timepoint	PDL score (1-5)	Comment	DBS score (1-5)	Comment
Week 3	☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5		☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5	
Week 6	☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5		☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5	
Week 9	☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5		☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5	

Section C: Self-Assessment Questionnaire for patient satisfaction

Scale:

☐ Satisfied (3–5) ☐ Dissatisfied (1–3)

Timepoint	Side	Redness Reduction	Appearance Improvement	Comfort	Side Effect Tolerance	Overall Satisfaction
Week 3	PDL	☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5	☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5	☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5	☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5	☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5
	DBS	☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5	☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5	☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5	☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5	☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5
Week 6	PDL	☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5	☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5	☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5	☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5	☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5
	DBS	☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5	☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5	☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5	☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5	☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5
Week 9	PDL	☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5	☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5	☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5	☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5	☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5
	DBS	☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5	☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5	☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5	☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5	☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5

Section D: Adverse Effects (Patient Self-Report)

Severity Scale:

1 = Very Mild 2 = Mild 3 = Moderate 4 = Severe 5 = Very Severe

Repeat for each timepoint if adverse events occur.

Timepoint	Adverse Effect	Side	Severity (1-5)	Durarion (days)	Comment
Week ☐ 3 ☐ 6 ☐ 9	Redness	☐ PDL ☐ DBS	☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5		
	Swelling	☐ PDL ☐ DBS	☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5		
	Burning	☐ PDL ☐ DBS	☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5		
	Itching	☐ PDL ☐ DBS	☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5		
	Dryness	☐ PDL ☐ DBS	☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5		
	Hyperpigmentation	☐ PDL ☐ DBS	☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5		
	Other	☐ PDL ☐ DBS	☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5		

Investigator Signature: _____

Date: _____

APPENDIX D

PATIENT'S SATISFACTION QUESTIONNAIRE

Participant ID: _____

Date: _____

Please rate your experience for each treatment side using the scale below:

1 = Very Dissatisfied, 2 = Dissatisfied, 3 = Neutral, 4= Satisfied, 5 = Very Satisfied

Question	PDL side	DBS side
1. Satisfaction with redness reduction	1 2 3 4 5	1 2 3 4 5
2. Cosmetic appearance improvement on this side	1 2 3 4 5	1 2 3 4 5
3. Comfort during treatment	1 2 3 4 5	1 2 3 4 5
4. Satisfaction with side effect profile (e.g., less irritation, less downtime)	1 2 3 4 5	1 2 3 4 5
5. Overall satisfaction with treatment	1 2 3 4 5	1 2 3 4 5

Satisfied = score 3-5, Dissatisfied = score 1-3

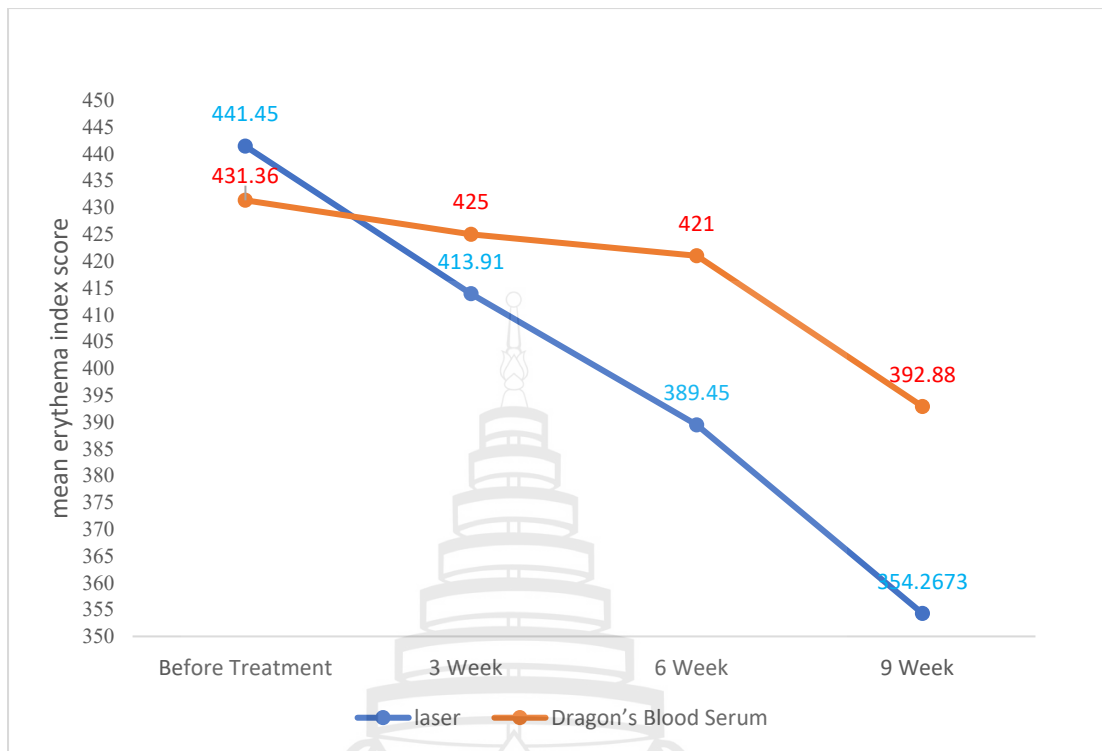


Figure D1 Linear graph shows comparison of mean erythema index scores in each period between laser and Dragon's Blood Serum treatment

Figure D1 presents mean erythema index before treatment and 3 weeks after treatment of each session. The reduction of mean erythema index indicates the improvement of post inflammatory erythema. The graph demonstrates a more pronounced decrease in erythema index in the laser group compared with the serum group.

Both treatments showed significant clinical improvement over time.

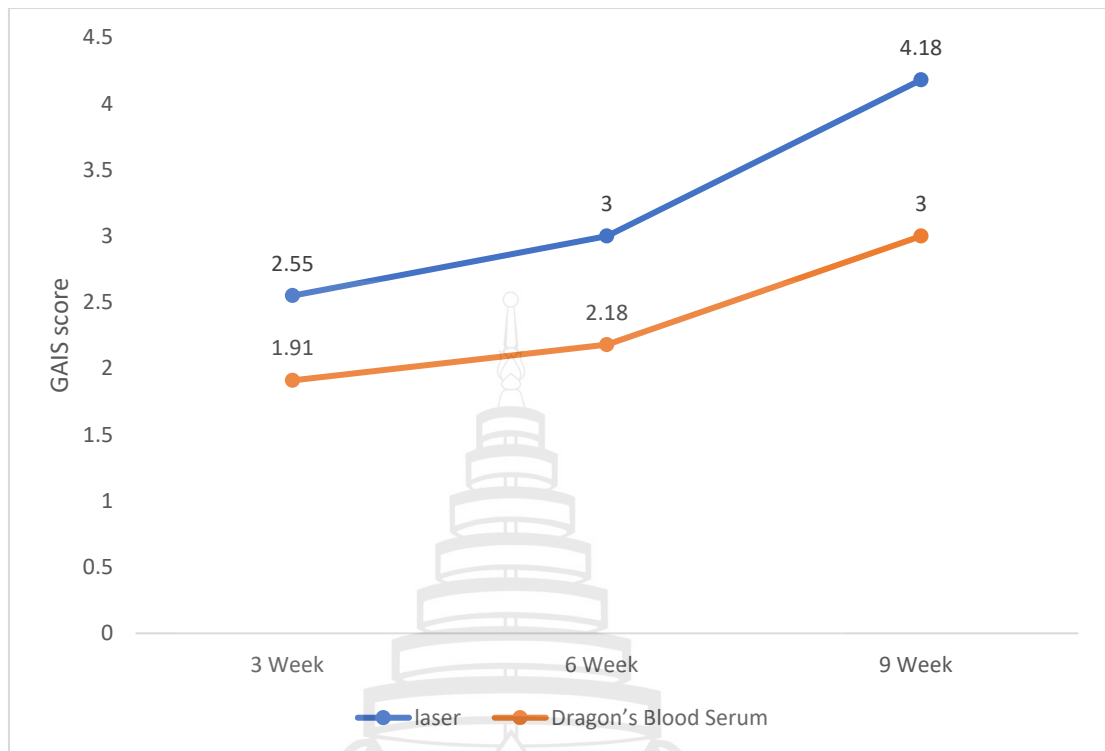


Figure D2 Line graph shows the changes of GAIS score in both treatment sides after treatment at 3rd, 6th and 9th week

Figure D2 represents comparison of difference of post inflammatory erythema (GAIS scores) from baseline and 3week intervals follow up after each treatment session. The graph shows greater improvement in GAIS scores in laser-treated side.

CURRICULUM VITAE

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Myitkyina General Hospital

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