

THE EFFICACY OF THE COMBINATION OF INTENSE PULSED LIGHT THERAPY AND PLATELET-RICH PLASMA WITH PLATELET-RICH PLASMA ALONE FOR FACIAL REJUVENATION

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ARTICLE HISTORY

Received: 6 March 2026

Revised: 27 March 2026

Published: 10 April 2026

ABSTRACT

Skin aging is a multifactorial process characterized by collagen degradation, reduced elasticity, wrinkle formation, and impaired barrier function. This randomized split-face clinical trial evaluated the efficacy and safety of combined intense pulsed light (IPL) and platelet-rich plasma (PRP) therapy compared with PRP monotherapy for facial rejuvenation in 12 healthy participants aged 25–45 years with grade 2–3 wrinkles. Each participant received IPL plus PRP on one side of the face and PRP alone on the contralateral side at four-week intervals for three sessions. Outcomes were assessed at baseline and at weeks 4, 8, and 12 using VISIA® wrinkle analysis, Cutometer® for skin viscoelasticity, Tewameter® for transepidermal water loss (TEWL), Global Aesthetic Improvement Scale (GAIS), patient satisfaction scores, and adverse-event monitoring. The combination therapy demonstrated significantly greater improvements in wrinkle scores, skin viscoelasticity, and TEWL reduction compared with PRP alone ($p < 0.05$), along with enhanced collagen remodeling and improved overall skin tone. Higher GAIS and patient satisfaction scores were observed in the IPL+PRP group. Adverse effects were mild and transient, with no serious complications reported. These findings suggest that combination therapy is a safe and more effective non-invasive treatment than monotherapy for comprehensive facial rejuvenation.

Keywords: Intense Pulsed Light, Platelet-rich Plasma, Facial Rejuvenation, Skin Aging, Wrinkle Reduction

CITATION INFORMATION: Eaint, Y., Pawcsuntorn, T. (2026). The Efficacy of the Combination of Intense Pulsed Light Therapy and Platelet-rich Plasma with Platelet-rich Plasma Alone for Facial Rejuvenation. *Procedia of Multidisciplinary Research*, 4(4), 6.

INTRODUCTION

Skin aging is a natural process influenced by both internal and external factors. As we age, our skin loses elasticity and firmness due to a decline in collagen and elastin production. Key contributors to skin aging include genetic factors, sun exposure, lifestyle choices, and environmental influences like pollution, UV radiation. To combat skin aging, it's important to protect the skin from the sunlight, maintain a healthy lifestyle, and proper use of skincare products (Banihashemi et al., 2021). Skin rejuvenation involves the elimination and regeneration of the skin, resulting in a more structured, youthful dermal matrix and normalized epidermis (Ross et al., 2022). Non-invasive facial rejuvenation treatments are gaining popularity for their effectiveness without requiring surgery (Huang et al., 2020). Among them, platelet-rich plasma (PRP) demonstrates positive effects on facial rejuvenation, whether used independently or in conjunction with other treatments like laser procedures, subcision, and growth factors. In contrast, ablative techniques, despite causing considerable patient discomfort and downtime with potential adverse events, can be contrasted with non-ablative methods such as intense pulsed light (IPL) therapy (Gade et al., n.d.) (Mei & Wang, 2018). There have been reports that intense pulsed light (IPL) therapy is beneficial in treating aging skin. IPL therapy uses continuously applied strong pulsed photons as a low-energy, low-density, non-ablative treatment. After IPL enters the tissues, hemoglobin and melanin specifically absorb it, causing photothermal effects. IPL has the ability to temporarily damage collagen through heat and stimulate the contraction and restructuring of collagen fibers. This process, known as photo-rejuvenation, leads to beneficial effects on the skin (Mei & Wang, 2018). Platelet-rich plasma (PRP), made from a patient's own plasma, is widely used for non-invasive facial rejuvenation. It contains growth factors that are believed to aid in tissue repair, gene regulation for cell growth and differentiation, and promote new blood vessel formation. This cellular rejuvenation may offer longer-lasting results compared to invasive procedures. (Xiao et al., 2021). The combination of intense pulsed light (IPL) therapy and platelet-rich plasma (PRP) offers a powerful, safe and effective approach to overall facial rejuvenation. PRP, derived from the patient's own blood, is rich in growth factors that stimulate collagen production and promote tissue regeneration. When paired with IPL, which effectively addresses vascular concerns and pigmentation irregularities, this dual therapy can target a wide range of cosmetic concerns. PRP enhances the skin's natural repair processes, improving its health and amplifying the outcomes of IPL treatments. Together, these therapies provide a non-invasive solution that helps patients achieve a more youthful, radiant and refreshed appearance.

LITERATURE REVIEWS

Skin Anatomy and Aging

The skin is a complex organ composed of three primary layers: epidermis, dermis, and hypodermis, each contributing to structural integrity, immune defense, thermoregulation, and barrier function (Cao et al., 2020). The dermis, rich in collagen and elastin fibers, provides tensile strength and elasticity, while the hypodermis contributes to volume and metabolic regulation. Skin aging is influenced by intrinsic factors such as genetic predisposition and hormonal changes, and extrinsic factors including ultraviolet (UV) radiation, pollution, and lifestyle habits (Xiao et al., 2021). Chronological aging leads to dermal thinning, reduced fibroblast activity, collagen fragmentation, decreased elastin organization, and diminished hyaluronic acid production (Kim et al., 2014) (Shin et al., 2023). Photoaging, primarily induced by UV-A and UV-B exposure, accelerates matrix metalloproteinase activation, collagen degradation, and oxidative stress, resulting in wrinkles, laxity, dyspigmentation, and telangiectasia (Porter et al., 2021). Structural changes also occur in deeper facial compartments,

including fat redistribution and skeletal remodeling, contributing to volume loss and sagging (Coleman & Grover, 2006).

Intense Pulsed Light Therapy for Facial Rejuvenation

Intense pulsed light (IPL) therapy is a non-ablative phototherapy modality based on selective photo-thermolysis, targeting chromophores such as hemoglobin and melanin (Goldberg, 2012). By delivering broad-spectrum light with adjustable wavelength, pulse duration, and fluence, IPL induces controlled thermal injury that stimulates collagen remodeling and improves pigmentation and vascular irregularities (Gade et al., n.d.)(Husain & Alster, 2016). IPL has been approved for various dermatologic indications, including photo-rejuvenation, lentigines, vascular lesions, and wrinkles (Goldberg, 2012). Clinical studies demonstrate significant improvement in periorbital aging, solar lentigines, skin texture, and elasticity with minimal downtime (Barikbin et al., 2019). Combination approaches with fractional lasers have further enhanced wrinkle reduction and skin quality without compromising barrier function (Mei & Wang, 2018).

Platelet-rich Plasma for Facial Rejuvenation

Platelet-rich plasma (PRP) is an autologous concentration of platelets containing numerous growth factors, including platelet-derived growth factor (PDGF), transforming growth factor- β (TGF- β), and vascular endothelial growth factor (VEGF), which promote tissue regeneration and angiogenesis (Buzalaf & Levy, 2022). Upon activation, platelets release bioactive proteins that stimulate fibroblast proliferation, collagen synthesis, extracellular matrix remodeling, and hyaluronic acid production (Dhurat & Suresh, 2014)(Anitua et al., 2007). PRP has been widely applied in aesthetic dermatology for wrinkle reduction, acne scars, skin laxity, and overall rejuvenation (Xiao et al., 2021). Clinical studies report improvements in skin texture, firmness, and elasticity with favorable safety profiles and minimal adverse effects (Aust et al., 2018). However, regenerative capacity may decline with age due to reduced cellular responsiveness to growth factors (Vavken et al., 2010).

Combination Therapy for Facial Rejuvenation

Combination therapy has gained increasing interest as a strategy to target multiple mechanisms of skin aging simultaneously. Integrating energy-based devices with biologic stimulators enhances clinical outcomes while minimizing downtime (Hui et al., 2017). Studies combining fractional CO₂ laser with PRP demonstrated superior wrinkle reduction, improved texture, and reduced post-procedural inflammation compared to monotherapy (Kar & Raj, 2017). Similarly, IPL combined with other modalities has shown enhanced efficacy in improving photoaging, erythema, and pigmentation disorders (Liang & Li, 2022). The synergistic rationale of combining IPL and PRP lies in IPL-induced collagen remodeling and vascular targeting, alongside PRP-mediated growth factor stimulation and accelerated tissue repair. This multimodal approach may provide comprehensive rejuvenation with improved patient satisfaction and safety.

RESEARCH METHODOLOGY

This study is a randomized split-face human experimental study. Twelve healthy male and female participants, aged 25-45 years, exhibiting wrinkles with grade 2 or 3 according to wrinkle severity rating scale (WSRS) and participants who want to undergo facial rejuvenation will be recruited at Mae Fah Luang University Hospital, Bangkok, Thailand. The goal of the study, each step of the protocol, the potential side effects of the treatment, and the benefits will be addressed by the researcher. History taking will be done and an informed consent form must be signed by participants. Prior to the procedure, VISIA® Skin Complexion Analysis System

for wrinkles, Cutometer® MPA 580 for skin elasticity and Tewameter® TM 300 for transepidermal water loss will be used to measure the parameters of each participant whose face has already been washed with water and soap. Cutometer and Tewameter will be put on both cheeks and right and left side of forehead to measure the skin elasticity and TEWL respectively at baseline and each follow-up session on 4th, 8th and 12th weeks. All photograph data will be documented by using a code number and the eyes will be obscured to make confidentially. Using a random number table generated by Excel, IPL will be performed to the left side of the face of the odd-numbered patients and to the right side of the face of the even-numbered patients. First of all, topical anesthetics, EMLA cream (2.5% lidocaine and 2.5% prilocaine) will be applied to face for 30 minutes before the treatment and then cleansed with water. As a first procedure, Cooled gel (1-2 mm thick) will be applied to the treated areas to avoid IPL induced damage to the epidermis of the skin and an eye shield will also be placed. IPL (MaxG™ handpiece, Palomar Icon™, Cynosure®) with range 500 – 670 & 870 – 1200 nm of wavelength, single pulse mode, 20 ms of pulse duration, 10 x 15 mm of spot size and 20 J/cm² of fluence will be used. Then, applied gel will be removed and all treated areas will be covered with ice pack while waiting for PRP preparation to avoid certain complications. As a second procedure, the patient's blood (10 ml) will be extracted by venipuncture and collected in a tube that contains anticoagulants (ACD) and cell separator gel under aseptic technique. Double centrifugation technique will be used. The first spin will be 1200 rpm for 10 min and then, the supernatant plasma containing platelets and buffy coat will be transferred into another sterile tube (without anticoagulant). The second spin will be 3500 rpm for 5 min to obtain a platelet concentrate. The lower one-third is PRP and upper two-third will be platelet-poor plasma (PPP). PPP will be removed and the platelet pellets will be suspended in a minimum quantity of plasma (3 mL). Later, the treatment areas will be disinfected by using iodine, and then the iodine will be removed by using 75% alcohol. PRP will then be injected to both cheeks and forehead. A 30 gauged needle will be used for intradermal injections by mesotherapy technique (point by point) by the investigator under guidance of Aj Tanomkit and the injections will be spaced about 1 cm apart. Immediately after injection, gentle pressure with gauze will be applied for 5 minutes. All post treatment complications such as pain, swelling, burn, numbness and other side effects will be assessed. Then, the investigator's own moisturizer and sunscreen will be applied to participants' face as post-treatment care. All post treatment care such as avoiding sun exposure, applying sunscreen (at least SPF 45) and moisturizer will be advised to all subjects. PRP and IPL treatments will be done on week 0, 4 and 8 (3 sessions) together with follow-up measurements. Measurements only will be done on week 12, no more treatment. At each follow up visit, all subjects will be assessed by cutometer, tewameter and visia scan and effectiveness will be evaluated by comparing mean changes of wrinkle score, skin elasticity and TEWL from baseline to week 4, 8 and 12. Global Aesthetic Improvement Scale (GAIS) by researcher and two independent physicians and Participant's Satisfaction Score will be assessed at week 12. The adverse effects on both sides of the face will be recorded by using research questionnaires like pain score, duration of erythema or swelling, post inflammatory hyperpigmentation or hypopigmentation, infection at every visit.

RESEARCH RESULTS

Participant Demographics

This study included 12 healthy participants (6 males, 6 females; mean age of 30.75±3.28 years). None of them had any underlying disease, photosensitivity or drug induced photosensitivity, active facial skin condition and previous facial treatment.

Clinical Evaluation

Primary and secondary outcomes were evaluated at baseline and at weeks 4, 8, and 12 by using SPSS software. Statistical analysis was performed to compare mean changes between the combination therapy side and the monotherapy side, with significance set at $p < 0.05$. Data were analyzed by Paired t-test (a): between groups, by Repeated ANOVA (b): within group and multiple comparison analysis (Post-hoc test).

According to Wrinkle Scores, combination therapy produced significantly greater wrinkle improvement than monotherapy at all follow-ups: 4th week ($63.92 \pm 16.56 > 49.5 \pm 19.00$), 8th week ($74.08 \pm 13.24 > 58.17 \pm 17.54$) and 12th week ($81.5 \pm 11.07 > 62 \pm 15.80$). The difference between treatments increased over time, indicating a stronger cumulative effect. Multiple comparison analysis confirmed that wrinkle scores in both monotherapy and combination therapy groups improved significantly from baseline to 4th, 8th, and 12th weeks ($p < 0.05$). However, combination therapy showed significantly greater improvement than monotherapy at all time points, with the largest difference observed at week 12.

Table 1 Wrinkle Scores measurement between monotherapy and combination therapy

	Monotherapy	Combination Therapy	Paired Difference	p-value(a)
	Mean $\pm$ SD	Mean $\pm$ SD		
Baseline	45 $\pm$ 21.46	52.25 $\pm$ 21.27	7.25 $\pm$ 0.20	0.04
4th week	49.5 $\pm$ 19.00	63.92 $\pm$ 16.56	14.42 $\pm$ 2.44	<0.001
8th week	58.17 $\pm$ 17.54	74.08 $\pm$ 13.24	15.92 $\pm$ 4.30	<0.001
12th week	62 $\pm$ 15.80	81.5 $\pm$ 11.07	19.5 $\pm$ 4.73	<0.001
p-value(b)	<0.001	<0.001		

Note: p-value(a) Paired t-test between groups and p-value(b) Repeated ANOVA within group

Table 2 Multiple comparison analysis (Post-hoc test) of Wrinkle Scores

Compare to		Monotherapy	Combination Therapy
		p-value	p-value
Baseline	4th week	<0.001	<0.001
Baseline	8th week	<0.001	<0.001
Baseline	12th week	<0.001	<0.001
4th week	8th week	<0.001	<0.001
4th week	12th week	<0.001	<0.001
8th week	12th week	<0.001	<0.001

Below Tables showed that combination therapy produced significantly greater viscoelasticity score than monotherapy at each follow-up visits: 4th week ($67.06 \pm 8.92 > 59.23 \pm 7.56$), 8th week ($77.32 \pm 6.65 > 64.35 \pm 7.13$) and 12th week ($84.61 \pm 6.88 > 69.03 \pm 8.13$). Over time, the difference between therapies increased, demonstrating a more potent effect.

Table 3 Viscoelasticity Score measurement between monotherapy and combination therapy

	Monotherapy	Combination Therapy	Paired Difference	p-value(a)
	Mean $\pm$ SD	Mean $\pm$ SD		
Baseline	60.11 $\pm$ 10.86	58.00 $\pm$ 7.62	-2.10 $\pm$ 3.24	0.19

4th week	59.23±7.56	67.06±8.92	7.83±1.37	<0.001
8th week	64.35±7.13	77.32±6.65	12.98±0.48	<0.001
12th week	69.03±8.13	84.61±6.88	15.56±1.25	<0.001
p-value(b)	<0.001	<0.001		

Note: p-value(a) Paired t-test between groups and p-value(b) Repeated ANOVA within group

Table 4 Multiple comparison analysis (Post-hoc test) of Viscoelasticity Scores

Compare to		Monotherapy	Combination Therapy
		p-value	p-value
Baseline	4th week	>0.05	<0.001
Baseline	8th week	<0.001	<0.001
Baseline	12th week	<0.001	<0.001
4th week	8th week	<0.001	<0.001
4th week	12th week	<0.001	<0.001
8th week	12th week	<0.001	<0.001

According to Table 5, combination therapy produced significantly lesser Trans-epidermal water loss score than monotherapy at each follow-up: 4th week ($17.93 \pm 1.26 < 20.15 \pm 1.48$), 8th week ($15.76 \pm 1.00 < 18.53 \pm 0.83$) and 12th week ($14.6 \pm 0.97 < 17.22 \pm 0.98$). Over time, both monotherapy and combination therapy mean values decreased. Furthermore, combination therapy's mean values are lower than those of monotherapy (mean = $17.61 \pm 3.32 < 19.46 \pm 2.04$).

Table 5 Trans-epidermal Water Loss measurement between monotherapy and combination therapy

	Monotherapy	Combination Therapy	Paired Difference	p-value(a)
	Mean±SD	Mean±SD		
Baseline	21.93±1.82	22.14±1.90	0.21±0.08	0.19
4th week	20.15±1.48	17.93±1.26	-2.23±0.22	<0.001
8th week	18.53±0.83	15.76±1.00	-2.77±0.17	<0.001
12th week	17.22±0.98	14.6±0.97	-2.62±0.01	<0.001
p-value(b)	<0.001	<0.001		

Note: p-value(a) Paired t-test between groups and p-value(b) Repeated ANOVA within group

Table 6 Multiple comparison analysis (Post-hoc test) of Trans-epidermal Water Loss Scores

Compare to		Monotherapy	Combination Therapy
		p-value	p-value
Baseline	4th week	<0.001	<0.001
Baseline	8th week	<0.001	<0.001
Baseline	12th week	<0.001	<0.001
4th week	8th week	<0.001	<0.001
4th week	12th week	<0.001	<0.001
8th week	12th week	<0.001	<0.001

GAIS in monotherapy showed 41.67% of “Much Improved” and 58.33% of “Improved” whereas 50% in “Very Much Improved” and another 50% in “Much Improved” were indicated in combination therapy. Data was presented by Wilcoxon Signed Ranks Test. Significant p-value<0.05.

Table 7 GAIS between Monotherapy and Combination Therapy at week 12

	Monotherapy (n=12)	Combination Therapy (n=12)
1.Very much improved	0	6
2.Much improved	5	6
3.Improved	7	0
4.No change	0	0
5.Worse	0	0

Table 8 Statistical Analysis of GAIS at 12th week

	Monotherapy (n=12)	Combination Therapy (n=12)	p-value
	Median (IQR)	Median (IQR)	
12 th week	3 (2-3)	1.5 (1-2)	0.002

The frequency distribution of participants’ satisfactory scores in which 3 of them reported “moderately satisfy” and 9 of them reported “greatly satisfy” in combination therapy group whereas each half of the participants reported “moderately satisfy” and “greatly satisfy” in monotherapy group.

Table 9 Frequency of Participants’ Satisfactory Score at 12th week

Participants’ Satisfactory Score	Monotherapy (n=12)	Combination Therapy (n=12)
Score 0= not satisfy	0	0
Score 1= mildly satisfy	0	0
Score 2= moderately satisfy	6	3
Score 3= greatly satisfy	6	9

Pain scores were rated equally by participants between monotherapy and combination therapy. 75% of participants rated pain score 0-3 and 25% of them rated pain score 4-6.

Table 10 Pain Score

	Monotherapy (n=12)	Combination Therapy (n=12)
Pain score 0-3	9	9
Pain score 4-6	3	3
Pain score 7-10	0	0

Table 11 Erythema or Swelling

	Monotherapy (n=12)	Combination Therapy (n=12)
Slight Erythema or Swelling	5	7

During the treatment period, erythema or slight swelling was occurred which was transient and relieved after 4-5 hours of procedure. No serious adverse events were seen in both therapies.

DISCUSSION AND CONCLUSION

This randomized split-face clinical study evaluated the efficacy of combining intense pulsed light (IPL) therapy with platelet-rich plasma (PRP) compared with PRP monotherapy for facial rejuvenation. The results demonstrated that the combined IPL + PRP treatment produced greater improvements in wrinkle reduction, skin viscoelasticity, and epidermal barrier function compared with PRP alone over the 12-week observation period. These findings support the hypothesis that multimodal therapy targeting different mechanisms of skin aging can provide superior clinical outcomes. Wrinkle assessment using the VISIA® analysis system showed a greater reduction in wrinkle scores on the side treated with the combination therapy. The improvement observed in this study is consistent with previous reports demonstrating that IPL induces dermal remodeling through selective photothermolysis, stimulating collagen contraction and neo-collagenesis (Mei & Wang, 2018) (Goldberg, 2012). PRP, on the other hand, promotes tissue regeneration by releasing multiple growth factors such as platelet-derived growth factor (PDGF), transforming growth factor- β (TGF- β), and vascular endothelial growth factor (VEGF), which stimulate fibroblast proliferation and extracellular matrix production (Nanda et al., 2021) (Dhurat & Sukesh, 2014). The combined approach likely enhances dermal remodeling through both thermal stimulation from IPL and biological regeneration from PRP, resulting in greater wrinkle improvement compared with PRP alone. In addition to wrinkle reduction, the combination therapy demonstrated a more pronounced improvement in skin viscoelasticity measured by Cutometer®. Increased viscoelasticity reflects enhanced dermal structural integrity and collagen organization. Previous studies have shown that PRP stimulates fibroblast activity and increases collagen synthesis, contributing to improved skin elasticity (Xiao et al., 2021). Meanwhile, IPL-induced thermal injury triggers wound healing responses that promote collagen remodeling (Goldberg, 2012). The synergistic interaction between these mechanisms may explain the superior elasticity improvement observed in the combination therapy group. The study also revealed a reduction in trans-epidermal water loss (TEWL), particularly on the side receiving IPL combined with PRP. TEWL is an important indicator of epidermal barrier function and skin hydration. Improvement in TEWL suggests restoration of the skin barrier and increased dermal hydration. Growth factors present in PRP can stimulate hyaluronic acid production and enhance dermal extracellular matrix composition, which improves skin hydration and barrier function (Anitua et al., 2007). At the same time, IPL may indirectly contribute to epidermal renewal and dermal matrix reorganization, further supporting improved barrier integrity. From a clinical perspective, according to the Global Aesthetic Improvement Scale (GAIS), participants receiving the combination therapy experienced greater overall aesthetic improvement at week 12. Higher satisfaction scores reported by participants may reflect visible improvements in skin texture, elasticity, and wrinkle appearance according to participants' satisfactory score. Previous research has also reported that multimodal facial rejuvenation approaches tend to achieve higher patient satisfaction compared with single-modality treatments because they address multiple aging pathways simultaneously (Mei & Wang, 2018) (Hui et al., 2017). Importantly, the safety profile observed in this study was favorable. Only mild and transient adverse effects, such as erythema, swelling, or mild pain, were reported, and these resolved spontaneously without complications. This finding aligns with previous studies indicating that both IPL and PRP are minimally invasive procedures with low risk of severe adverse effects when performed under appropriate clinical protocols (Gade et al., n.d.) (Xiao et al., 2021). The absence of serious complications further supports the feasibility of this combined approach for routine clinical practice. Despite these promising outcomes, certain limitations must be acknowledged. The relatively small sample size limits statistical power and generalizability. The 12-week follow-up period does not allow evaluation of long-term

durability. Histological confirmation was not performed due to ethical and cosmetic considerations. In addition, lifestyle-related variables such as diet, sleep, and environmental exposure could not be strictly controlled. However, this study demonstrated that the combination of intense pulsed light (IPL) therapy and platelet-rich plasma (PRP) is a safe and effective approach for facial rejuvenation. Compared with PRP monotherapy, the combined treatment resulted in greater improvement in wrinkle reduction, skin viscoelasticity, and epidermal barrier function, along with higher physician-assessed aesthetic improvement and patient satisfaction with no serious adverse effects. The synergistic effects of IPL-induced photothermal stimulation and PRP-mediated biological regeneration contribute to these enhanced outcomes. Overall, the combined IPL and PRP therapy represents a promising non-invasive strategy for comprehensive facial rejuvenation and may serve as an effective alternative for patients seeking minimally invasive anti-aging treatments.

REFERENCES

- Anitua, E., Sánchez, M., Nurden, A. T., Zalduendo, M. M., De la Fuente, M., Azofra, J., & Andía, I. (2007). Platelet-released growth factors enhance the secretion of hyaluronic acid and induce hepatocyte growth factor production by synovial fibroblasts from arthritic patients. *Rheumatology*, 46(12), 1769–1772. <https://doi.org/10.1093/rheumatology/kem234>
- Aust, M., Pototschnig, H., Jamchi, S., & Busch, K.-H. (2018). Platelet-rich Plasma for Skin Rejuvenation and Treatment of Actinic Elastosis in the Lower Eyelid Area. *Cureus*. <https://doi.org/10.7759/cureus.2999>
- Banihashemi, M., Zabolinejad, N., Salehi, M., Alamdari, Z. H., & Nakhaizadeh, S. (2021). Platelet-rich plasma use for facial rejuvenation: A clinical trial and review of current literature. *Acta Biomedica*, 92(2). <https://doi.org/10.23750/abm.v92i2.9687>
- Barikbin, B., Akbari, Z., Vafae, 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>
- Buzalaf, M. A. R., & Levy, F. M. (2022). Autologous platelet concentrates for facial rejuvenation. *Journal of Applied Oral Science*, 30. <https://doi.org/10.1590/1678-7757-2022-0020>
- Cao, C., Xiao, Z., Wu, Y., & Ge, C. (2020). Diet and skin aging—from the perspective of food nutrition. In *Nutrients* (Vol. 12, Number 3). MDPI AG. <https://doi.org/10.3390/nu12030870>
- Coleman, S. R., & Grover, R. (2006). The anatomy of the aging face: Volume loss and changes in 3-dimensional topography. *Aesthetic Surgery Journal*, 26(1 SUPPL.). <https://doi.org/10.1016/j.asj.2005.09.012>
- Dhurat, R., & Sukesh, M. (2014). Principles and methods of preparation of platelet-rich plasma: A review and author's perspective. *Journal of Cutaneous and Aesthetic Surgery*, 7(4), 189. <https://doi.org/10.4103/0974-2077.150734>
- Gade, A., Vasile, G. F., & Rubenstein, R. (n.d.). *Intense Pulsed Light (IPL) Therapy Continuing Education Activity*.
- Goldberg, D. J. (2012). Current Trends in Intense Pulsed Light. In *J Clin Aesthet Dermatol* (Vol. 5, Number 6).
- Huang, A., Nguyen, J. K., Austin, E., Mamalis, A., Cohen, M., Semkhaev, B., Ho, D., & Jagdeo, J. (2020). Facial rejuvenation using photodynamic therapy with a novel preparation of ALA and hyaluronic acid in young adults. *Archives of Dermatological Research*, 312(8), 567–573. <https://doi.org/10.1007/s00403-020-02038-5>
- Hui, Q., Chang, P., Guo, B., Zhang, Y., & Tao, K. (2017). The clinical efficacy of autologous platelet-rich plasma combined with ultra-pulsed fractional CO2 laser therapy for facial rejuvenation. *Rejuvenation Research*, 20(1), 25–31. <https://doi.org/10.1089/rej.2016.1823>

- Husain, Z., & Alster, T. S. (2016). The role of lasers and intense pulsed light technology in dermatology. In *Clinical, Cosmetic and Investigational Dermatology* (Vol. 9, pp. 29–40). Dove Medical Press Ltd. <https://doi.org/10.2147/CCID.S69106>
- Kar, B. R., & Raj, C. (2017). Fractional CO₂ laser vs fractional CO₂ with topical platelet-rich plasma in the treatment of acne scars: A split-face comparison trial. *Journal of Cutaneous and Aesthetic Surgery*, 10(3), 136–144. https://doi.org/10.4103/JCAS.JCAS_99_17
- Kim, J., Nakasaki, M., Todorova, D., Lake, B., Yuan, C. Y., Jamora, C., & Xu, Y. (2014). P53 induces skin aging by depleting Blimp1+ sebaceous gland cells. *Cell Death and Disease*, 5(3). <https://doi.org/10.1038/cddis.2014.87>
- Liang, Y., & Li, L. (2022). The Combination of Red and Blue Light, Radiofrequency and Intense Pulsed Light for the Treatment of Facial Postacne Erythema. *Clinical, Cosmetic and Investigational Dermatology*, 15, 2383–2389. <https://doi.org/10.2147/CCID.S389705>
- Mei, X. L., & Wang, L. (2018). Ablative fractional carbon dioxide laser combined with intense pulsed light for the treatment of photoaging skin in Chinese population. *Medicine (United States)*, 97(3). <https://doi.org/10.1097/MD.00000000000009494>
- Nanda, S., Chauhan, K., Shetty, V., Dashore, S., & Bhatia, S. (2021). Platelet-Rich Plasma in Aesthetics. *Indian Dermatology Online Journal*, 12(7), S41–S54. https://doi.org/10.4103/idoj.idoj_290_21
- Porter, H. L., Brown, C. A., Roopnarinesingh, X., Giles, C. B., Georgescu, C., Freeman, W. M., & Wren, J. D. (2021). Many chronological aging clocks can be found throughout the epigenome: Implications for quantifying biological aging. *Aging Cell*, 20(11). <https://doi.org/10.1111/acel.13492>
- Ross, E. V., Tidwell, W. J., Guss, L., & Sutton, A. V. (2022). Study of a 532/1064 Fractional Picosecond Laser for Facial Rejuvenation. *Dermatologic Surgery*, 48(1), 109–113. <https://doi.org/10.1097/DSS.00000000000003229>
- Shin, S. H., Lee, Y. H., Rho, N. K., & Park, K. Y. (2023). Skin aging from mechanisms to interventions: focusing on dermal aging. In *Frontiers in Physiology* (Vol. 14). Frontiers Media S.A. <https://doi.org/10.3389/fphys.2023.1195272>
- Vavken, P., Saad, F. A., & Murray, M. M. (2010). Age dependence of expression of growth factor receptors in porcine ACL fibroblasts. *Journal of Orthopaedic Research*, 28(8), 1107–1112. <https://doi.org/10.1002/jor.21111>
- Xiao, H., Xu, D., Mao, R., Xiao, M., Fang, Y., & Liu, Y. (2021). Platelet-rich plasma in facial rejuvenation: A systematic appraisal of the available clinical evidence. In *Clinical, Cosmetic and Investigational Dermatology* (Vol. 14, pp. 1697–1724). Dove Medical Press Ltd. <https://doi.org/10.2147/CCID.S340434>

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.

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