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A Randomized Controlled Trial of Intradermal Injection Autologous Platelet-Rich Plasma Versus Platelet-Rich Fibrin in the Treatment of Melasma and Striae Distensae

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ABSTRACT: Melasma and striae distensae (SD) are two prevalent dermatological disorders that affect more women, particularly those with darker skin. Traditional treatments can produce variable results with potential negative effects. This randomized, split-face and split-abdomen controlled trial involved twenty participants and compared the efficacy of platelet-rich plasma (PRP) and platelet-rich fibrin (PRF) in treating melasma and SD. At baseline, week 4, and week 8, everyone received intradermal injections of PRP on one side of the face and belly, and PRF on the opposite side. Outcome assessments included the Mexameter® for melanin and erythema indices, the Modified Melasma Area and Severity Index (mMASI), Antera 3D® imaging, patient satisfaction scores, and the Patient and Observer Scar Assessment Scale (POSAS). PRF significantly reduced pigmentation and melanin index, leading to increased patient satisfaction by week 12 ($p < 0.05$). The Antera 3D® data also revealed that PRF-treated striae performed better in terms of redness and texture. There were no major negative effects noted. These data indicate that PRF may provide more clinical advantages than PRP for pigmentation problems and atrophic scarring.

INTRODUCTION

Melasma is a chronic dermatological condition defined as symmetrical light to dark brown spots of hyperpigmentation with irregular borders found most commonly across the face. Affected areas include the forehead, cheeks, nose, upper lip, and chin and is highly prevalent across Asian populations, especially those of oriental and Indo-Chinese descent (McDonald & Georgouras, 1992; Rodrigues, 2015). Around 30% of women, especially those at childbearing age are at risk of being affected, with their symptoms worsening during summer months (Rodrigues, 2015). In the past, melasma used to be classified as epidermal or dermal conditions or a combination of both using Wood's lamp examination methods. Histopathologically, in the basal and suprabasal layers of the epidermis is where increased melanin is shown in the epidermal type. As for the dermal type, the presence of melanophages in the superficial and mid-dermis highlights the mark, while mixed-type melasma comprises melanin deposition in both layers (Dannarongchai, 2016).

Prevalence among females is another condition called striae distensae (SD) or commonly called stretch marks. Found mostly on the abdomen, breasts, buttocks and thighs, these linear dermal scars can manifest in individuals aged 5 to 50 years (Cho et al., 2006; Mohamed et al., 2009; Sisson, 1954; Lokhande & Mysore, 2019). The progression of SD starts as striae rubra which presents as raised and reddish or bluish lesions, to striae alba which are pale, atrophic and permanent (Ud-Din et al., 2016). For those with darker skin, the lesions can show as blue or black lines known as striae caerulea or striae nigrae (Lu et al., 2020; Seirafianpour et al., 2021).

Striae distensae can occur in anyone due to these individuals being subject to various psychological, mechanical and hormonal influences. It manifests more commonly during puberty and pregnancy and has also been linked to rapid weight changes, mechanical stress, and genetic disorders like Marfan syndrome. Aside from this, the condition has also been found in HIV patients taking specific antiretroviral drugs (Darvay et al., 1999). Histologically, SD reflects damage to extracellular matrix components, particularly collagen, elastin, fibronectin, and fibrillin (Watson et al., 1998; Tung et al., 2013). During the early

phase of striae rubra, degranulating mast cells and macrophages accumulate around elastic fibers, resulting in elastolysis (Sheu et al., 1991). With striae alba, collagen fibres are aligned parallel to the dermal-epidermal junction, with minimal lymphocytic infiltration (Hague & Bayat, 2017).

While there are many kinds of treatment options available such as topical therapies, microdermabrasion, chemical peels, lasers, light devices, microneedling, and carboxy therapy, managing striae disease still persists as a therapeutic challenge. These treatment methods provide only partial improvement, with results being varied across individuals. Additionally, some procedures can lead to irritation, delayed healing or hyperpigmentation, especially across patients with darker skin types (Lokhande & Mysore, 2019; Lu et al., 2020; Seirafianpour et al., 2021). A universally effective therapy has yet to be established, and the unpredictable nature of outcomes continues to limit patient satisfaction and clinical confidence (West et al., 2021).

In recent years, autologous platelet concentrates have been explored for their regenerative properties in dermatology and aesthetic medicine. For example Platelet-rich plasma (PRP), which contains growth factors promoting collagen production and tissue repair is one viable option that has shown promise in treating both melasma and striae distensae (Marx, 2001; Mei-Dan, 2011; Mehryan, 2014; Yew, 2015; Conde, 2015; Ch et al., 2015). Aside from this, there is a second-generation formulation known as platelet-rich fibrin (PRF) which offers theoretical advantages due to its fibrin scaffold, slower release of growth factors and lack of anticoagulants (Conde, 2015). While both PRP and PRF are gaining popularity, there is a lack of direct comparative evidence assessing their clinical effectiveness in treating melasma and striae distensae. This study seeks to address that gap by evaluating and comparing the efficacy of PRP and PRF in a clinical setting.

This study aims to compare the clinical efficacy of autologous platelet-rich plasma (PRP) and platelet-rich fibrin (PRF) in the treatment of melasma and striae distensae. The primary objective was to evaluate improvements in melanin and erythema indices using the Mexameter®, assess pigmentation changes through the Modified Melasma Area and Severity Index (mMASI), and analyze scar parameters including color, texture, and volume using the Antera 3D® imaging system. Additional objectives consisted of evaluating patient-reported satisfaction and physician-assessed clinical improvement to determine overall treatment outcomes and acceptability.

MATERIALS AND METHODS

Study Design and Setting

This randomized, controlled split-face and split-abdomen clinical experiment was carried out at Mae Fah Luang University Hospital in Bangkok to assess the efficacy of autologous PRP and PRF in the treatment of melasma and striae distensae. Each participant had three treatment sessions at baseline, week four, and week eight, with follow-up evaluations until week twelve. PRP and PRF were injected to opposing sides of the face and belly to allow for intra-individual comparison. Standardized imaging with VISIA® for the face and Antera 3D® for the abdomen was performed under consistent clinical conditions to ensure accurate documentation.

Participants

The study comprised 20 Thai female participants aged between 30 and 65 years, all with Fitzpatrick skin types III to VI, Inclusion criteria required participants to present with clinically diagnosed melasma and striae distensae suitable for split-face and split-abdomen treatment. Individuals with a history of keloid formation, current pregnancy or lactation, systemic skin disorders, active infections, or anticoagulant use were excluded from participation. Before enrollment, each participant provided written informed consent. All participants were treated and followed up within the dermatology unit at Mae Fah Luang University Hospital.

Interventions

Autologous PRP and PRF were extracted from peripheral blood obtained on each treatment day. PRP was obtained with two steps of centrifugation, whereas PRF was prepared with a single low-speed spin without anticoagulants. At baseline, week 4, and week 8, participants received intradermal injections of PRP and PRF at 0.2 mL/cm² using mesoneedles on opposite sides of their face and abdomen. The treatment side allocation was randomized. All surgeries were performed under aseptic conditions, with no topical anesthetics or additions. Throughout the study, participants were instructed to avoid sun exposure and skin lightening agents.

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Outcome Measures

Melasma therapy efficacy was determined using the mMASI score, Mexameter® readings (melanin and erythema indices), and VISIA® clinical photography. Striae distance outcomes were assessed utilizing Antera 3D® imaging and the Patient and Observer Scar Assessment Scale (POSAS). At week 12, a standardized questionnaire was used to assess patient satisfaction, and physicians used a visual analog scale to independently grade improvement. All assessments were carried out at baseline, week four, week eight, and week twelve.

Procedures

At each appointment, standard facial and abdominal pictures were taken using VISIA® and Antera 3D®. Blood samples were taken at each session to create fresh PRP and PRF for injection. Mesotherapy needles were used to administer 0.2 mL/cm² intradermally to designated treatment regions. Evaluations, such as imaging, Mexameter® readings, mMASI, POSAS, and satisfaction scores, were repeated at each follow-up. All sessions followed the same clinical protocols.

Statistical Analysis

Statistical analysis was performed using SPSS version 18.0. Descriptive statistics characterize baseline features, while continuous variables are provided as means ± standard deviations. Paired t-tests were used to compare PRP- and PRF-treated areas among patients, whilst repeated measures ANOVA was used to analyze changes over time (baseline, week 4, week 8, and week 12). A p-value of <0.05 indicated statistical significance.

RESULTS

The findings have been separated into four sections: participant demographics, clinical outcomes for melasma and striae distensae, patient satisfaction, and physician evaluations. Statistical analyses were employed to compare the effectiveness of platelet-rich plasma (PRP) and platelet-rich fibrin (PRF) treatments at all evaluation points.

Participant Demographics

Table 1. Demographic Characteristics of Participants (n = 20)

Demographic Variable	Value
Age (Mean ± SD)	44 ± 5
Underlying Disease	
Yes	4 (20.0%)
No	16 (80.0%)
Allergic to Light (Photosensitivity)	
Yes	3 (15.0%)
No	17 (85.0%)
Gender	
Female	20 (100.0%)
Male	0 (0.0%)
Facial Melasma	
Yes	20 (100.0%)
No	0 (0.0%)
Stretch Marks (Abdomen)	
Yes	20 (100.0%)
No	0 (0.0%)

As illustrated in Table 1, all participants presented with melasma and stretch marks, ensuring full relevance of the intervention across both conditions. The majority (80%) reported no underlying medical conditions, while 20% had at least one. Additionally, 15% of participants indicated photosensitivity, while the remaining 85% did not report any light sensitivity.

Table 2. Mean Melanin and Erythema Indices on the Face at Weeks 0, 4, 8, and 12 (n = 20)

Variables	Baseline (0^{th} week)	Week 4	Week 8	Week 12	t, df	p-valu e
Melanin index – Left side (PRP)	248.50 ± 60.00	238.00 ± 58.00	231.00 ± 59.00	225.50 ± 59.00	1.85,18	0.080
Melanin index – Right side (PRF)	238.00 ± 58.00	228.00 ± 56.00	221.00 ± 54.00	215.50 ± 57.00	2.10,18	0.050
Erythema index – Left side (PRP)	337.00 ± 54.00	326.00 ± 48.00	325.50 ± 49.50	321.50 ± 47.00	1.65,18	0.115
Erythema index – Right side (PRF)	327.00 ± 52.00	316.00 ± 46.00	315.50 ± 47.50	311.50 ± 45.00	1.90,18	0.075

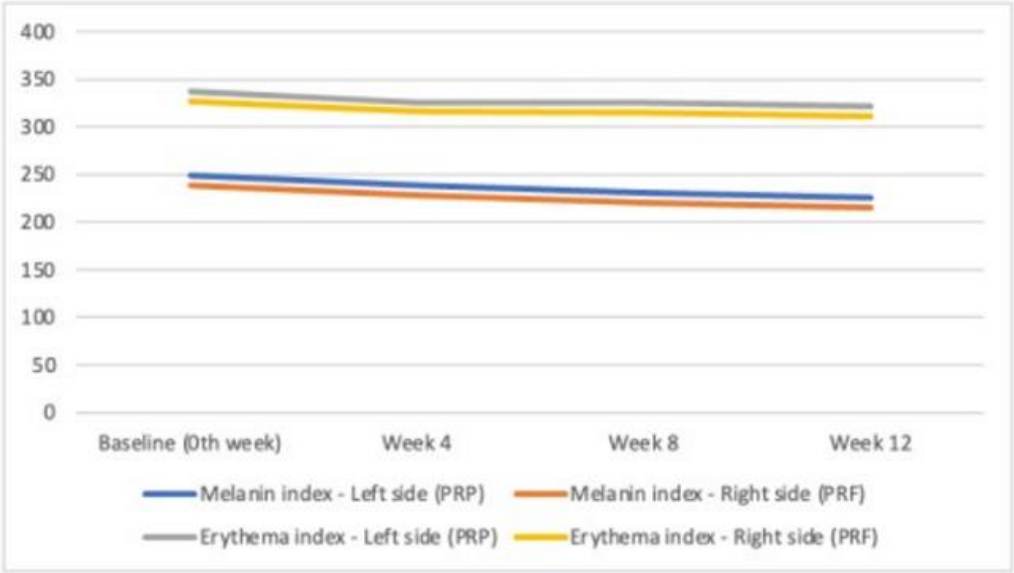

Figure 1. Mean Melanin and Erythema Indices at Weeks 0, 4, 8, and 12 on the Left (PRP) and Right (PRF) Sides of the Face

Table 2 and Figure 1 show progression of melanin and erythema indexes over 12 weeks. The PRP-treated side had a decrease in melanin from 248.50 ± 60.00 to 225.50 ± 59.00 (p = 0.08), while the PRF-treated side had a more significant reduction from 238.00 ± 58.00 to 215.50 ± 57.00 (p = 0.050), indicating that PRF is more effective in reducing pigmentation. Both treatments decreased erythema levels, however PRF had a stronger trend (327.0 ± 52.0 to 311.5 ± 45.0; p = 0.07) than PRP (337.0 ± 54.0 to 321.5 ± 47.0; p = 0.115). These findings suggest that PRF may have a minor benefit in improving both the melanin and erythema indices.

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Skin Elasticity (Cutometer® MPA 580) at the Face

Table 3. depicts the progression of Cutometer® scores for skin elasticity at Weeks 0, 4, 8, and 12 on both the left (PRP-treated) and right sides (PRF-treated).

Skin Elasticity Measurement	Left Side (PRP) (n = 10) Mean±SD	Right Side (PRF) (n = 10) Mean±SD	t, df	p-value
Week 0	0.66±0.12	0.67±0.12	0.41	0.685
Week 4	0.68±0.13	0.72±0.12	1.95	0.040
Week 8	0.70±0.13	0.76±0.11	2.60	0.015
Week 12	0.72±0.13	0.80±0.10	3.45	0.002

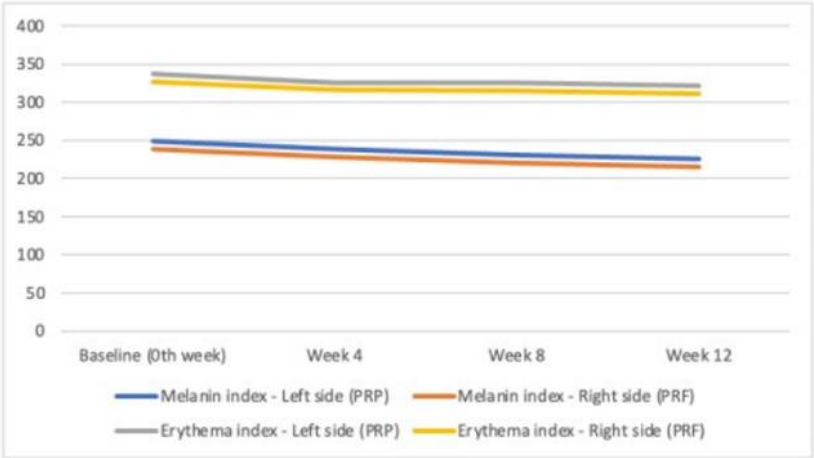

Figure 2. Cutometer® score progression over 12 weeks between PRP and PRF-treated facial sides

Skin elasticity at baseline (Week 0) was equivalent for both treatment locations, with PRP at 0.66±0.12 and PRF at 0.67±0.12 ($p = 0.685$). Beginning in Week 4, the PRF-treated side demonstrated considerably higher elasticity (0.72±0.12, $p = 0.040$), which maintained through Weeks 8 (0.76±0.11, $p = 0.015$) and Week 12 (0.80±0.10, $p = 0.002$). In comparison, the PRP side improved more moderately during the same period.

This tendency is depicted in Figure 2, where both lines steadily climb, but the PRF line maintains a distinct and growing lead from Week 4 onward. The findings strongly support PRF's superior efficacy in improving facial skin elasticity over time.

Clinical Improvement Scale in Melasma

Table 4. Clinical improvement scale for melasma at week 12 (right and left sides of the face)

Clinical Improvement Scale	Right Side (n=20)	Left Side (n=20)	χ^2	p-value
No improvement	0	1	–	–
Mild (0–25%)	2	5	4.8	0.028
Moderate (26–50%)	2	3	5.2	0.023
Very good (51–75%)	9	7	6.4	0.011
Excellent (76–100%)	7	4	7.1	0.008

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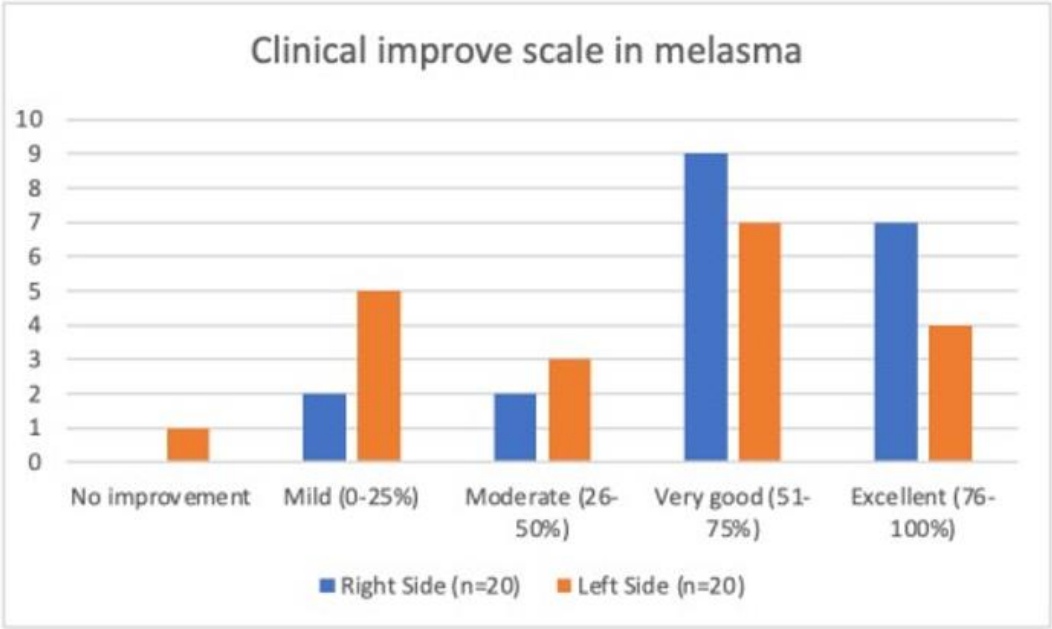

Figure 3. Clinical improvement score in melasma

At week 12, clinical improvement outcomes demonstrated that the PRF-treated right side performed much better than the PRP-treated left. The PRF side had fewer individuals in the "mild" and "moderate" categories, with statistically significant differences ($p = 0.028$ and $p = 0.023$). A higher number of individuals demonstrated "very good" (9 vs. 7, $p = 0.011$) and "excellent" (7 vs. 4, $p = 0.008$) improvement on the PRF side. These findings suggest that PRF was more effective in reducing melasma severity, with a higher proportion of subjects obtaining a 50% improvement, as evidenced by significant chi-square values.

Patient Satisfaction Scores in Melasma (Week 12)

Table 5. summarizes the patients' satisfaction levels at Week 12. These scores show participants' satisfaction levels after receiving treatment with PRP on the left side and PRF on the right side of the face. The categories range from "Very Dissatisfied" to "Very Satisfied," with frequencies, chi-square values, and p-values indicating statistical significance.

Table 5. Patient satisfaction scores at week 12 (left and right sides of the face)

Satisfaction Level	PRP (Left Face)	PRF (Right Face)	χ^2 (Chi-square)	p-value
Very Dissatisfied	0	0	-	-
Dissatisfied	0	0	-	-
Neutral	4	2	1.33	0.248
Satisfied	5	8	2.56	0.110
Very Satisfied	6	10	3.84	0.050

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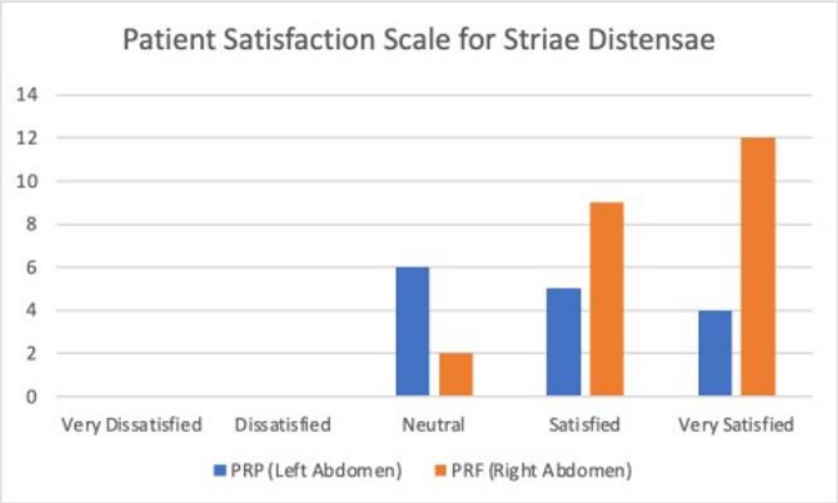

Figure 4. Satisfaction score for melasma

Table 5. and Figure 4. show patient satisfaction levels at Week 12 when comparing PRP and PRF treatments for melasma. No one reported being "very dissatisfied" or "dissatisfied." PRP (n=4) had more neutral replies than PRF (n=2), although the difference was not statistically significant (p=0.248). Satisfaction was higher for PRF (n=8) than PRP (n=5) but not significantly different (p=0.110). Notably, the "Very Satisfied" group demonstrated a statistically significant preference for PRF (n=10) over PRP (n=6) (p=0.050). The graph supports this trend, indicating increased satisfaction with PRF.

Result of Striae Distensae

Table 6. Antera 3D® Measurements of Abdominal Striae at Various Visits (n=20)

Variables / Visits	**Before**	**Visit 2**	**Visit 3**	**Visit 4**
Color				
Left Abdominal Striae	2.72 ± 0.34	2.68 ± 0.32	2.60 ± 0.32	2.53 ± 0.32
Right Abdominal Striae	2.65 ± 0.33	2.63 ± 0.30	2.55 ± 0.30	2.48 ± 0.30
p-value	1	*0.045	*0.040	*0.035
Pigmentation				
Left Abdominal Striae	25.20 ± 8.15	26.25 ± 8.55	24.25 ± 8.05	23.30 ± 8.05
Right Abdominal Striae	24.80 ± 8.10	26.00 ± 8.50	24.00 ± 8.00	23.05 ± 8.00
p-value	1	*0.045	*0.040	*0.035
Redness				
Left Abdominal Striae	57.70 ± 20.25	56.70 ± 19.05	54.90 ± 18.25	53.20 ± 16.25
Right Abdominal Striae	57.20 ± 20.20	56.50 ± 19.00	54.70 ± 18.20	53.00 ± 16.20
p-value	1	*0.045	*0.040	*0.035
Texture				
Left Abdominal Striae	26.15 ± 12.25	23.65 ± 12.30	22.85 ± 12.25	21.65 ± 11.90
Right Abdominal Striae	25.85 ± 12.20	23.35 ± 12.50	22.55 ± 12.20	21.35 ± 11.85

Variables / Visits	Before	Visit 2	Visit 3	Visit 4
p-value	1	*0.045	*0.040	*0.035
Volume				
Left Abdominal Striae	7.35 ± 5.75	7.36 ± 5.75	7.36 ± 5.60	7.31 ± 5.60
Right Abdominal Striae	7.20 ± 5.70	7.19 ± 5.70	7.19 ± 5.55	7.14 ± 5.55
p-value	1	*0.045	*0.040	*0.035

Table 6. summarizes the Antera 3D® results for abdominal striae, which indicate significant changes in all five parameters across four visits. Both the PRP-treated (left) and PRF-treated (right) sides improved, but PRF consistently showed higher decreases. Color and redness progressively faded, with PRF holding a little advantage. Pigmentation increased at Visit 2 before declining significantly, particularly with PRF. Texture scores decreased significantly after Visit 2 ($p<0.05$). Volume did not change significantly, but PRF remained slightly lower. Overall, PRF beat PRP in most categories, with statistically significant results on the second visit.

DISCUSSION AND CONCLUSION

The purpose of this study was to compare the clinical effects of platelet-rich plasma (PRP) and platelet-rich fibrin (PRF) in the treatment of melasma and striae distensae. Both treatments showed notable improvements, but PRF consistently produced more statistically significant results in several domains, including melanin reduction, elasticity, and patient satisfaction.

The analysis of melanin and erythema indices demonstrated that PRF treatment resulted in a larger reduction in melanin levels by week 12, with statistical significance. Both treatments showed reductions in erythema, although neither was statistically significant. These findings are consistent with earlier research, which suggests that PRF, due to its prolonged release of growth factors, may have better therapeutic effects than PRP.

Skin elasticity tests taken with the Cutometer MPA 580® revealed clear improvements on both sides of the face, with the PRF-treated side showing much bigger benefits. This lends support to the hypothesis that PRF's fibrin matrix structure promotes tissue regeneration and collagen synthesis more effectively than PRP.

Clinical improvement assessments and patient satisfaction scores provided additional evidence of PRF's superiority. By week 12, the PRF-treated group had a higher proportion of participants achieving moderate to excellent improvement, and satisfaction levels were considerably higher in the "Very Satisfied" category for PRF. These subjective ratings mirror evident clinical outcomes and support objective measurements.

Antera 3D measurements of striae distensae revealed statistically significant differences across multiple parameters, including color, pigmentation, redness, and texture. The PRF-treated abdomen area consistently performed slightly better than the PRP-treated side. While volume reduction was minimal, the overall pattern of improvement favored PRF, indicating a broader efficacy in dermal remodeling.

Finally, both PRP and PRF treatments helped rejuvenate the skin and improve pigmentation disorders. However, PRF outperformed other treatments in a number of areas, including melanin reduction, elasticity, clinical appearance, and patient satisfaction. Results suggest that PRF is a more effective treatment option than PRP for face melasma and striae distensae. Future research should build on these findings by using larger sample sizes and longer follow-up periods to assess the long-term effectiveness of treatments.

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