

Platelet-Rich Plasma for Facial Skin Rejuvenation: A Narrative Review of Mechanisms, Clinical Applications, and Efficacy

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Abstract

Facial aging develops through progressive loss and reorganization of collagen and elastin, with visible changes that include wrinkles, uneven pigmentation, laxity, and post-acne scarring. Platelet-rich plasma (PRP) is an autologous blood product in which platelets are concentrated above baseline, commonly to about 4 - 6 times the circulating level. Its relevance to facial rejuvenation comes from the release of mediators such as platelet-derived growth factor (PDGF), vascular endothelial growth factor (VEGF), transforming growth factor-beta (TGF-beta), and epidermal growth factor (EGF). Together, these mediators can influence fibroblast activity, angiogenesis, extracellular-matrix turnover, and melanogenesis. We reviewed 40 sources published from 2020 to 2026 to examine how PRP and closely related platelet-derived products are being used in facial rejuvenation. The literature was considered across four clinically distinct areas: photoaging and skin quality, periorbital or pigmentary concerns, atrophic acne scarring, and volume-related problems. Improvements have been reported with PRP alone and with adjunctive treatment, although the strongest comparator-controlled findings are confined to particular combinations, especially microneedling and fractional laser approaches. Results are less consistent for pigmentary and volume-related indications, where PRP has not always performed better than the comparator. Short-term tolerability is generally favorable, and the adverse effects described in clinical studies are usually mild and self-limited. The longer-term safety picture is less certain because follow-up is often brief. Interpretation of efficacy is also complicated by differences in PRP preparation, treatment schedules, comparators, outcome measures, sample size, and duration of observation. More consistent

product reporting, better-defined comparator trials, validated outcome instruments, and longer follow-up are needed before indication-specific treatment protocols can be considered established.

Keywords

Platelet-Rich Plasma, Facial Rejuvenation, Skin Aging, Platelet-Rich Fibrin, Cosmetic Dermatology

1. Introduction

Facial aging reflects both intrinsic processes, including genetic and hormonal influences, and cumulative external exposures such as ultraviolet radiation, pollution, and smoking. Clinically, these changes may appear as loss of elasticity, wrinkling, laxity, irregular pigmentation, volume loss, or post-acne scarring [1]. Interest in minimally invasive regenerative procedures has therefore grown, and PRP has become one of the autologous treatments increasingly used in aesthetic practice.

PRP is produced from a patient's own blood by centrifugation, creating a plasma fraction enriched with platelets, often to approximately 4 - 6 times the baseline concentration. The preparation contains growth factors including PDGF, VEGF, TGF-beta, and EGF, together with cytokines and fibrin that participate in tissue repair. Because it is autologous and can be delivered through relatively minor procedures, PRP has attracted particular interest for facial rejuvenation.

Clinical use of PRP predates its expansion into aesthetic medicine; it has been used in fields such as orthopedics and plastic surgery since the 1990s [2]. Facial applications have increased, but the evidence has remained difficult to compare because studies use different preparation methods, dosing schedules, and outcome assessments [3]-[5]. This review therefore examines the recent literature on biological mechanisms, clinical uses, efficacy, factors that may influence response, and the main limitations of PRP-based facial rejuvenation.

Throughout this review, the term "facial skin rejuvenation" is used broadly, while the clinical evidence is interpreted within four groups: photoaging and skin-quality outcomes (wrinkles, texture, elasticity, and laxity), periorbital or pigmented concerns, atrophic acne scars, and volume-related concerns such as infraorbital hollows. Studies of neck rejuvenation are included only when they provide adjacent cervicofacial evidence and are not treated as primary facial outcomes.

2. Methods

We designed this article as a narrative review supported by a structured literature search and independent screening by two authors. It was not intended to meet the methodological requirements of a systematic review: no protocol registration, formal PRISMA process, quantitative meta-analysis, or formal risk-of-bias instru-

ment was used. The findings should therefore be read as a structured narrative synthesis rather than an exhaustive systematic review.

The literature search was completed on February 15, 2026, using PubMed, Scopus, Web of Science, and Google Scholar. In PubMed, we used the following Boolean strategy: (“platelet-rich plasma” OR “PRP” OR “platelet rich plasma” OR “platelet-rich fibrin” OR “PRF”) AND (“facial rejuvenation” OR “skin aging” OR “anti-aging” OR “facial aging” OR “wrinkles” OR “skin laxity” OR “periorbital” OR “acne scars”) AND (“clinical” OR “efficacy” OR “mechanism”). Equivalent terms were adapted to the field syntax of Scopus (TITLE-ABS-KEY) and Web of Science (TS=). Google Scholar was searched using “platelet-rich plasma facial rejuvenation”, and forward citation tracking of key papers was used to locate additional potentially relevant studies.

Eligible publications evaluated PRP, PRF, or a closely related autologous platelet/plasma product for human facial rejuvenation, or supplied translational mechanistic evidence directly relevant to that use. We included papers reporting clinical, histologic, imaging, patient-reported, or mechanistic outcomes and limited the search to peer-reviewed English-language publications from January 2020 through February 15, 2026. Systematic reviews and meta-analyses were retained when they provided useful context. Editorials and letters without substantive data were excluded. Clinical studies were grouped in advance into photoaging/skin quality, periorbital or pigmentary concerns, atrophic acne scarring, and volume-related concerns; neck studies were handled as adjacent cervicofacial evidence. We also excluded unrelated non-facial indications, animal-only work, conference abstracts, duplicates, and reports without relevant data.

C.D.P. and K.S.T. independently screened the titles and abstracts of 124 unique records, with disagreements discussed with J.Z. Seventy-eight records were removed at this stage: 34 were off topic, 12 were animal studies, 18 were conference abstracts, 8 were duplicates, and 6 were non-English publications. Forty-six full texts were then assessed. Six did not meet the final criteria (four lacked substantive original or synthesis data and two were not sufficiently relevant to facial or cervicofacial rejuvenation), leaving 40 sources for the narrative synthesis. These counts are provided to make the selection process transparent; they should not be interpreted as evidence of an exhaustive PRISMA-conformant search.

We appraised study quality descriptively rather than applying a formal risk-of-bias tool. Much of the clinical literature consisted of small randomized or controlled split-face/split-site studies, pilot work, and single-center prospective studies. Most samples were in the range of about 10 - 40 participants, with relatively few larger cohorts, and follow-up commonly extended only from several weeks to 3 - 12 months. Evidence beyond one year was uncommon. These features, together with non-randomized designs and heterogeneous comparators and outcomes, limit the certainty of broad efficacy claims. **Table 1** summarizes the design and principal findings of representative studies included in the synthesis.

Table 1. Study characteristics table.

Author (Year)	Study Type	Sample Size	Intervention	Outcome	Interpretive Note
Xiao <i>et al.</i> (2021) [6]	Systematic review	36 studies, 3172 patients	PRP monotherapy; PRP + HA, lipofilling, microneedling, laser	PRP effective, combination better; need high-quality RCTs	Across 36 studies, the review found broadly favorable signals for PRP, including adjunctive use, but the authors emphasized marked protocol variation and the shortage of high-quality trials.
Rodríguez-Castro and Cortés-Rodríguez (2025) [1]	Systematic review	11 studies	PRP for facial rejuvenation	PRP effective; need standardized protocols	The 11-study review reported generally favorable outcomes, although heterogeneity was substantial and no single preparation method could be identified as optimal.
Abdel-Meguid <i>et al.</i> (2020) [7]	RCT	20 Patients	PRP + microdermabrasion vs PRP alone	Combined better for post-acne scars	This small randomized comparison favored PRP combined with microdermabrasion over PRP alone for post-acne scars.
Krishnegowda <i>et al.</i> (2023) [8]	Split-face RCT	30 patients	i-PRF + microneedling vs microneedling + saline	i-PRF + microneedling superior (62% vs 34% scar reduction)	In this split-face trial, adding i-PRF to microneedling produced greater scar reduction than microneedling with saline, although the sample remained small.
Anitua <i>et al.</i> (2022) [9]	<i>In vitro</i> + clinical	3 donors + HDFs	PRGF vs L-PRP	PRGF better fibroblast response	The fibroblast findings suggest that different blood-derived preparations may behave differently biologically. Translation to routine facial treatment is uncertain, and the industry affiliation should be considered.
Kadry <i>et al.</i> (2023) [10]	RCT (single-blind)	40 Patients	PRP vs autologous fat + nanofat	Both effective for dark circles; fat slightly better	Both approaches improved dark circles, but the fat/nanofat treatment provided greater correction of the volume component.
Iranmanesh <i>et al.</i> (2024) [11]	Split-site RCT	30 Patients	PRP vs tranexamic acid + vitamin C	Tranexamic acid + vitamin C superior for periorbital hyperpigmentation	For periorbital hyperpigmentation, the split-site randomized comparison favored tranexamic acid plus vitamin C rather than PRP.
da Silva <i>et al.</i> (2021) [2]	Non-randomized controlled	20 females	Lyophilized PRP vs control	Lyophilized PRP improved elasticity, texture	This non-randomized pilot reported improvement in selected elasticity and texture measures after lyophilized PRP; larger controlled studies are needed before drawing firm conclusions.

Continued

Kang <i>et al.</i> (2026) [12]	Clinical trial	30 Patients	Autologous blood-derived EVs	Improved skin regeneration, anti-aging	The study is relevant to platelet-derived signaling, but it evaluated autologous blood-derived extracellular vesicles rather than conventional clinical PRP.
Ejaz <i>et al.</i> (2025) [13]	Prospective comparative clinical study	65 participants	Microneedling + PRP vs microneedling + saline	Greater improvement with PRP combination (reported 43% vs 19%); higher satisfaction	Microneedling with PRP produced greater acne-scar improvement and higher satisfaction than microneedling with saline in this prospective comparison; the cohort was still modest in size.
Diab <i>et al.</i> (2022) [5]	Split-face trial	30 Patients	Plasma gel vs PRP	Both effective; plasma gel better for periorbital rejuvenation	Both PRP and plasma gel improved periorbital findings, with plasma gel performing better on some measures in the split-face comparison.
de Leon <i>et al.</i> (2026) [14]	Prospective study	30 Patients	PRP + HA	Safe and effective for neck rejuvenation	The neck study supports the feasibility of PRP with hyaluronic acid, but without a PRP-only arm the contribution of hyaluronic acid cannot be separated.
Evans <i>et al.</i> (2021) [15]	Systematic review + meta-analysis	10 studies	PRP for periorbital rejuvenation	PRP safe and effective	Pooled evidence suggested short-term periorbital benefit with acceptable tolerability, although the underlying studies used notably different protocols.
J. Lu <i>et al.</i> (2024) [16]	Clinical trial	26 Patients	Oxygen-rich PRP vs conventional PRP	Oxygen-rich PRP better outcomes	Oxygen-enriched PRP performed better on selected outcomes in this small comparison, but the method remains experimental.
Pensato <i>et al.</i> (2024) [17]	Retrospective observational	45 Patients	PRP in facial rejuvenation	Shorter recovery, better aesthetic outcome	The retrospective series described favorable recovery and aesthetic outcomes. Without randomization or a control group, causal interpretation is limited.
Nilforoushzadeh <i>et al.</i> (2021) [18]	Clinical trial	25 Patients	Fractional Er:YAG laser + PRP	Improved periorbital dark circles	Improvement was reported after fractional Er:YAG laser with PRP, but the design cannot show whether the combination is superior to either treatment alone.
Navarro <i>et al.</i> (2020) [19]	Comparative study	15 females	Endoret-Gel + PRGF vs Endoret-Gel alone	Combined therapy better	The comparison suggested an added effect from PRGF when used with Endoret-Gel, although commercial affiliation and limited independent replication weaken confidence in the finding.

Continued

Chan <i>et al.</i> (2021) [20]	<i>In vitro</i> + clinical	<i>In vitro</i> + 10 subjects	PRP extract (Self-Growth Colony)	Strong skin rejuvenation, anti-ageing	The work demonstrates biological activity of an optimized PRP extract, but the product and setting differ from routine injectable PRP used in clinical practice.
van Dongen <i>et al.</i> (2021) [21]	RCT (prospective)	24 Patients	SVF + PRP + lipofilling vs PRP + lipofilling	SVF addition did not improve skin quality	Adding stromal vascular fraction to PRP-assisted lipofilling did not produce an additional skin-quality benefit in this prospective randomized trial.
Nacopoulos and Vesala (2020) [22]	Case series	34 Patients	Liquid PRF matrices (Cleopatra technique)	Effective lower facial regeneration	The case series suggests that low-speed liquid PRF matrices can be used for lower-face regeneration, but there was no comparator.
Görgü <i>et al.</i> (2020) [23]	Clinical trial	20 Patients	PRP with Na-citrate vs ACD-A anticoagulant	Na-citrate causes less pain	Sodium citrate was associated with less injection pain than ACD-A. The study addresses tolerability rather than establishing a superior preparation protocol for efficacy.
Y. Lu <i>et al.</i> (2025) [24]	Case-control study	30 Patients	PRP + Q-switched ruby laser vs laser alone	Combined better for hyperpigmentation, less PIH	Adding PRP to Q-switched ruby laser was associated with better pigment outcomes and less post-inflammatory hyperpigmentation than laser alone.
Charles-de-Sá <i>et al.</i> (2020) [25]	RCT (prospective)	20 Patients	PRP vs ADSCs for photoaging	PRP induced dermal fibrosis; ADSCs improved elastin	PRP and adipose-derived stromal cells produced different histologic responses. The small sample limits how broadly the findings can be applied.
Qi <i>et al.</i> (2025) [26]	RCT	80 Patients	Low-energy CO ₂ laser + PRP vs laser alone	Combined better periorbital rejuvenation, higher satisfaction	The randomized study favored low-energy fractional CO ₂ laser plus PRP over laser alone for periorbital rejuvenation and patient satisfaction.
Du and Lei (2020) [27]	Split-face clinical trial	30 females	PRP vs saline	PRP reduced wrinkles, pores, pigment; increased collagen	Compared with saline on the opposite side of the face, PRP improved several photoaging measures, including wrinkles, pores, pigmentation, and collagen-related outcomes.
Maia <i>et al.</i> (2021) [28]	Controlled clinical trial	30 volunteers	Microneedling + growth factors vs microneedling + saline	Growth factors more collagen/elastin	Microneedling with growth-factor treatment produced greater histologic collagen and elastin changes than microneedling with saline, but the findings should not be generalized to every PRP protocol.

Continued

Hassan <i>et al.</i> (2020) [29]	Prospective case series	11 females	Injectable PRF (monthly ×3)	Improved spots, pores, texture; high satisfaction	Three monthly injectable PRF sessions were followed by improvement in several skin-quality measures and high satisfaction. The absence of a control group limits efficacy inference.
Neinaa <i>et al.</i> (2020) [30]	Split-face comparative	68 female patients	PPP gel vs PRP	Both effective; PPP gel better for infraorbital hollows	Both products improved infraorbital hollows, but PPP gel produced greater correction than PRP in the split-face comparison.
Akaranuchat and Kongkunnawat (2024) [31]	Clinical trial	40 Patients	Single PRP injection	Improved perceived age, elasticity, satisfaction	A single PRP treatment was followed by short-term improvement in perceived age, elasticity, and satisfaction; the study does not establish an optimal treatment schedule.
Shen <i>et al.</i> (2024) [3]	Clinical trial	36 Patients	PRP + skin booster	Effective and safe for aging face	PRP combined with a skin booster was reported as effective and safe, but the lack of a PRP-only comparator prevents separation of the skin-booster effect.
Umeda <i>et al.</i> (2025) [32]	Split-face trial	9 Adult participants	PRP mesotherapy vs saline	PRP increased facial gloss, trend of pore reduction	The small interim split-face analysis found objective improvement relative to saline, but nine participants are insufficient for firm dosing or scheduling conclusions.
Camargo <i>et al.</i> (2024) [33]	RCT pilot	20 Patients	PRP + ozone therapy vs PRP alone	Combined therapy better facial rejuvenation	The pilot trial favored PRP plus ozone over PRP alone, but the sample was too small for the result to be considered definitive.
Seoudy <i>et al.</i> (2023) [34]	Split-face study	20 Patients	CO ₂ laser vs CO ₂ laser + PRP	Combined better wrinkle improvement	In this split-face study, adding PRP to fractional CO ₂ laser produced greater wrinkle improvement than laser treatment alone.
Hersant <i>et al.</i> (2021) [35]	Clinical trial	31 Patients	PRP + HA	Synergistic facial skin rejuvenation	Facial improvement was reported with PRP plus hyaluronic acid; without a consistent PRP-only comparison, an additive effect from hyaluronic acid cannot be quantified.
Al Hassan <i>et al.</i> (2025) [36]	RCT blinded cohort	13 Patients	PRP + microneedling for periorbital area	Effective periorbital aesthetic rejuvenation	The randomized blinded cohort reported periorbital improvement with PRP plus microneedling, although the very small sample restricts protocol-specific conclusions.

Continued

Basyoni <i>et al.</i> (2022) [37]	Split-face comparative clinical study	20 patients	Microneedling + irradiated amniotic collagen matrix vs microneedling + PRP	Both improved; amniotic collagen matrix showed greater improvement on selected outcomes	Both sides improved, and the irradiated amniotic collagen matrix performed better on selected measures. The study therefore does not demonstrate PRP superiority.
Estupiñan <i>et al.</i> (2025) [38]	Split-face non-inferiority	10 Patients	Adipose exosomes vs PRP	PRP non-inferior to exosomes	PRP met the study's non-inferiority comparison with adipose-derived exosomes, but the split-face trial included only 10 participants and requires confirmation.
Tsai <i>et al.</i> (2024) [39]	Double-blind randomized split-face study	10 participants completed follow-up	PRP vs platelet-poor plasma (PPP)	Both sides improved; PRP showed a modest overall advantage on selected skin-quality measures	Both PRP and PPP sides improved in this very small double-blind study; the relative advantage of PRP depended on the outcome measured.
Pincelli <i>et al.</i> (2024) [4]	Clinical evaluation	24 Patients	PRP + microneedling	Effective for facial skin rejuvenation	Improvement was reported after PRP with microneedling, but limited comparator information makes it difficult to determine the added contribution of PRP.
Majewska <i>et al.</i> (2025) [40]	Ultrasound study	60 Participants	PRP & PRF by age groups	Age affects skin density/thickness improvement	The ultrasound findings suggest age-related differences in response, but they remain exploratory and are not sufficient to justify age-specific treatment protocols.

3. Clinical Protocols and Procedural Techniques

PRP preparations are often described according to leukocyte content. Leukocyte-poor PRP (LP-PRP) contains fewer white blood cells, whereas leukocyte-rich PRP (L-PRP) retains more leukocytes and may therefore carry a different cytokine and inflammatory profile [9].

Platelet-rich fibrin (PRF) is a related autologous product prepared without anticoagulant. The resulting fibrin network can retain platelets and growth factors, providing a matrix that supports cell attachment and tissue remodeling while allowing more sustained mediator release [8] [29].

3.1. PRP Preparation

PRP preparation begins with autologous blood collection followed by centrifugation, but the final product varies substantially with the protocol. Citrate-based anticoagulants such as ACD-A, sodium citrate, or CPD are commonly used [23]. Single- and double-spin methods differ in centrifugal force and duration and may yield platelet concentrations of roughly 3 - 6 times baseline. Leukocyte-poor prep-

arations are frequently used for facial indications in an attempt to limit inflammatory burden [35]. Activation may involve calcium salts, thrombin, or other processing methods, and newer variants include injectable PRF, oxygen-enriched PRP, and lyophilized PRP [2] [16] [22]. Across the literature, the most important practical issue is not a single preferred protocol but clear reporting of processing time, platelet and leukocyte content, centrifugation conditions, and activation. No preparation method has yet been validated as optimal for facial rejuvenation. **Figure 1** illustrates these steps.

Preparation and Clinical Application of Platelet-Rich Plasma (PRP) for Facial Rejuvenation

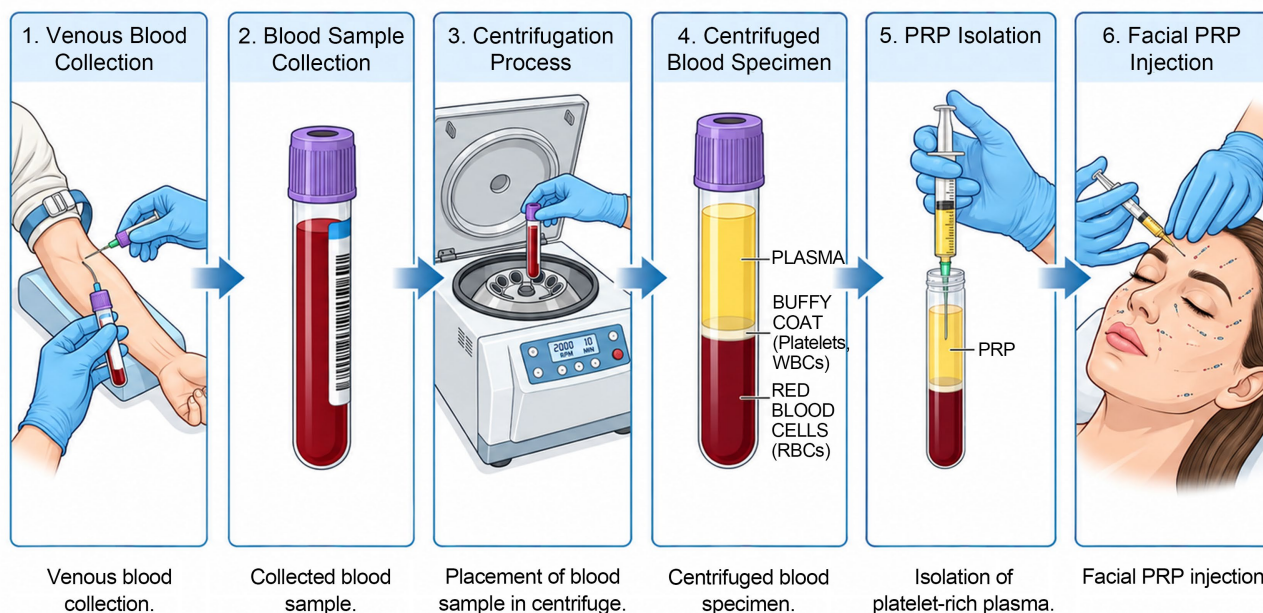


Figure 1. Step-by-step workflow for autologous platelet-rich plasma (PRP) preparation for facial skin rejuvenation.

3.2. Injection Techniques

Intradermal delivery varies with both indication and facial region. Nappage, linear threading, bolus injection, and mesotherapy techniques are all described, and full-face treatment commonly uses a total volume of approximately 2 - 6 mL [3].

3.3. Treatment Frequency

Treatment is usually delivered as a short course rather than a single fixed regimen. Many reports use 2 - 4 sessions spaced about 3 - 4 weeks apart, with maintenance treatment sometimes proposed at 6 - 12 months [32] [36]. Mild erythema, edema, or local tenderness may follow treatment and generally resolves within 24 - 72 hours [17].

3.4. Combination Therapies

The value of combining PRP with another procedure depends on what the combination was compared against. In atrophic acne scars, injectable PRF/PRP plus

microneedling performed better than microneedling with saline in a split-face randomized trial [8], and a controlled study found greater collagen and elastin changes when growth-factor treatment was added to microneedling rather than saline [28]. Other reports described improvement without an equivalent control arm [4] [13]. For fractional resurfacing, studies comparing fractional CO₂ laser plus PRP with laser alone reported greater improvement in wrinkles or periorbital outcomes [26] [34]. Fractional Er:YAG combined with PRP was also associated with clinical improvement, although that study design cannot determine whether the combination is better than either component alone [18]. Studies of PRP with hyaluronic acid reported improvement in facial or neck skin [14] [35], but the absence of a consistent PRP-only comparator prevents attribution of the effect to the added hyaluronic acid. In post-acne scarring, PRP with microdermabrasion outperformed PRP alone [7]. A small randomized pilot study also favored PRP plus ozone over PRP alone, but the finding remains preliminary [33]. In another split-face comparison, microneedling with irradiated amniotic collagen matrix produced at least comparable, and on some measures greater, improvement than microneedling with PRP [37]. Taken together, these studies do not support a single “combination therapy” effect; the result must be interpreted in relation to the specific comparator and design.

3.5. Outcome Assessment

Outcome assessment is not standardized across studies. Investigator- or patient-rated scales such as the Global Aesthetic Improvement Scale and Wrinkle Severity Rating Scale are used alongside objective imaging systems, including Antera 3D and VISIA, to quantify changes in texture, pigmentation, and vascularity [5] [32].

3.6. Molecular Mechanisms of PRP in Facial Skin Rejuvenation

The biological rationale for PRP involves several overlapping components rather than one pathway. Growth factors, cytokines, extracellular vesicles, and the fibrin-rich matrix may each contribute to dermal remodeling, angiogenesis, inflammatory regulation, and pigmentation. The strength of evidence is uneven, however. Human facial studies mainly report clinical or histologic changes, whereas many pathway-level explanations come from fibroblast experiments, non-facial regenerative research, or studies of platelet-derived products. The mechanisms discussed below are therefore plausible explanations for observed effects, not pathways demonstrated consistently in treated human facial skin.

Growth-factor signaling provides one of the clearest mechanistic links. PDGF can bind PDGFR-beta on dermal fibroblasts and activate Ras/MAPK and PI3K/Akt signaling, promoting fibroblast proliferation and type I and III collagen synthesis [9]. TGF-beta acts through Smad2/3 and is implicated in extracellular-matrix remodeling, including increased collagen deposition, reduced expression of MMP-1 and MMP-9, and increased TIMP-1 [6]. VEGF signaling through VEGFR-2 supports angiogenesis and dermal microcirculation. EGF, through EGFR/MAPK sig-

naling, can promote keratinocyte proliferation and migration and thereby contribute to epidermal renewal and barrier repair [11] [27].

PRP may also modify inflammatory and oxidative pathways involved in photoaging. Leukocyte-derived mediators such as IL-1 receptor antagonist, IL-4, and IL-10 can counter pro-inflammatory NF-kappaB signaling and reduce expression of TNF-alpha and IL-6. At the same time, antioxidant enzymes including superoxide dismutase and catalase can reduce reactive oxygen species, potentially limiting oxidative injury in dermal tissue [25].

Pigmentation is another proposed target. TGF-beta and related mediators have been linked to downregulation of microphthalmia-associated transcription factor (MITF), followed by lower tyrosinase expression and reduced melanin synthesis. This pathway has been proposed as one explanation for pigmentary improvement reported after PRP treatment, including in periorbital hyperpigmentation and melasma [10] [11].

Extracellular vesicles may account for part of the cell-to-cell signaling attributed to platelet-derived products. PRP-derived vesicles can carry bioactive molecules, including microRNAs such as miR-21 and miR-126, that have been associated with fibroblast survival and angiogenic signaling [12]. The fibrin component of PRP may add a structural effect by providing a three-dimensional matrix that supports cell adhesion and proliferation during tissue repair [29].

Direct confirmation of these pathways in human facial tissue is still limited. Studies that combine well-characterized PRP products with standardized clinical outcomes and paired tissue analysis would help distinguish mechanisms that are active in vivo from those inferred mainly from laboratory models. These clinical comparisons are summarized in **Table 2**.

Table 2. PRP facial rejuvenation: clinical subgroup, comparator, outcome, and design context.

Clinical subgroup/ indication	Intervention and comparator	Observed outcome	Representative evidence	Design context
Photoaging/fine wrinkles	PRP vs saline	Wrinkles, pores, pigmentation, and collagen-related measures improved	(Du & Lei, 2020) [27]	Split-face clinical trial
Global facial photoaging	PRP vs PPP	Both sides improved; PRP had a modest advantage on selected measures	(Tsai <i>et al.</i> , 2024) [39]	Double-blind randomized split-face study
Atrophic acne scars	i-PRF + microneedling vs microneedling + saline	Scar reduction was greater with the i-PRF combination (reported 62% vs 34%)	(Krishnegowda <i>et al.</i> , 2023) [8]	Split-face randomized trial
Post-acne scars	PRP + microdermabrasion vs PRP alone	Greater scar improvement with the combined approach	(Abdel-Meguid <i>et al.</i> , 2020) [7]	Randomized comparative study

Continued

Periorbital wrinkles	Fractional CO ₂ laser + PRP vs fractional CO ₂ laser alone	Greater improvement with laser plus PRP	(Qi <i>et al.</i> , 2025; Seoudy <i>et al.</i> , 2023) [34]	Comparative/ randomized evidence
Periorbital hyperpigmentation	PRP vs tranexamic acid + vitamin C	Both improved, but tranexamic acid plus vitamin C performed better for pigmentation	(Iranmanesh <i>et al.</i> , 2024) [11]	Split-site randomized trial
Periorbital dark circles	PRP vs autologous fat + nanofat	Both improved; fat/nanofat provided more volume correction	(Kadry <i>et al.</i> , 2023) [10]	Randomized comparative study
Periorbital hyperpigmentation	Q-switched ruby laser + PRP vs laser alone	Adding PRP improved pigmentation outcomes and reduced post-inflammatory hyperpigmentation	(Y. Lu <i>et al.</i> , 2025) [24]	Comparative case-control study
Infraorbital hollows	PPP gel vs PRP	Both improved; PPP gel produced greater hollow correction	(Neinaa <i>et al.</i> , 2020) [30]	Split-face comparative study
Facial skin quality/ laxity	PRP + hyaluronic acid; no consistent PRP-alone comparator	Improvement was reported, but the added effect of hyaluronic acid cannot be separated	(Hersant <i>et al.</i> , 2021) [35]	Clinical study
Neck rejuvenation (adjacent evidence)	PRP + hyaluronic acid; no PRP-alone comparator	Neck skin quality improved	(de Leon <i>et al.</i> , 2026) [14]	Prospective study
Periorbital rejuvenation	Plasma gel vs PRP	Both improved; plasma gel performed better on selected measures	(Diab <i>et al.</i> , 2022) [5]	Split-face comparative study

Note: PRP does not consistently outperform other autologous blood-derived products. In a split-face study of infraorbital hollows, platelet-poor plasma (PPP) gel produced greater volumetric correction than PRP [30]. This finding is important because it shows that treatment effects are indication- and comparator-specific rather than evidence of a general advantage for PRP.

4. Discussion

The clinical literature does not point to a uniform PRP effect across all indications. In photoaging and general skin quality, a split-face study found improvement with PRP compared with saline [27], whereas a small double-blind comparison of PRP and PPP found improvement on both sides and only a modest PRP advantage on selected measures [39]. A separate single-session study reported short-term gains in perceived age, elasticity, and satisfaction [31]. Evidence in atrophic acne scarring is more clearly comparator-based: PRP/PRF used with microneedling performed better than saline-controlled microneedling in one randomized study [8], and PRP plus microdermabrasion was superior to PRP alone [7]. Periorbital and pigmentary findings are mixed. Tranexamic acid plus vitamin C performed better than PRP for periorbital hyperpigmentation in one split-site trial [11], while add-

ing PRP to Q-switched ruby laser improved outcomes compared with laser alone [24]. A systematic review and meta-analysis reported short-term periorbital benefit and acceptable tolerability but also emphasized substantial protocol heterogeneity [15]. For infraorbital volume loss, PPP gel outperformed PRP [30]. Other comparative work reported PRP as non-inferior to adipose-derived exosomes for photoaged skin [38], while adding stromal vascular fraction to PRP-assisted lipofilling did not improve skin quality [21]. The practical message is that efficacy depends on the indication and on the treatment used as the comparator.

Another major limitation is the lack of a common treatment protocol. Studies differ in centrifugation method, platelet concentration, leukocyte content, activation, dose, treatment interval, and outcome measurement [3] [16] [32]. Favorable reports often used platelet enrichment in the approximate 4 - 6 times baseline range, leukocyte-poor products for facial treatment, and courses of about 2 - 4 sessions spaced 3 - 4 weeks apart [4] [35], but these are recurring patterns rather than validated optimal parameters. No activation strategy has shown consistent clinical superiority. The best comparator-supported adjunctive signals in this review were seen with microneedling [8] [28], fractional CO₂ laser [26] [34], and microdermabrasion [7]. Even for these approaches, confidence is constrained by small samples, split-face or non-randomized designs, inconsistent outcomes, and short follow-up [5] [38] [39].

The adverse events actually reported in facial studies were mainly local and short lived: erythema, edema, tenderness, bruising, and injection-site discomfort usually resolved within days [23]. In the small double-blind PRP-versus-PPP photoaging trial, no severe adverse events were reported [39]. These observations are reassuring for short-term use, but small studies are poorly suited to detect uncommon complications.

Longer-term safety is harder to judge because follow-up beyond one year is uncommon. One prospective comparison found greater dermal fibrosis after PRP than after adipose-derived stromal cells on histologic assessment [25]; the clinical meaning and generalizability of that observation remain uncertain. Calcification and immunologic sensitization, in contrast, are theoretical concerns rather than established adverse outcomes in the facial studies reviewed here. Longer prospective surveillance is therefore needed before the effects of repeated long-term exposure can be characterized confidently [1].

Several limitations of this review also need to be kept in view. The search and screening process was structured, but the review was not conducted as a systematic review: there was no registered protocol, formal PRISMA process, risk-of-bias scoring, or quantitative meta-analysis. Restricting inclusion to English-language papers published from 2020 to 2026 may have omitted relevant earlier or non-English evidence. In addition, the synthesis combines primary clinical studies with selected reviews and translational mechanistic reports. Reporting the screening process improves transparency, but it does not remove selection bias. The 40 included sources should therefore be regarded as a focused qualitative evidence base

rather than a complete systematic corpus.

Progress in this field will depend less on producing additional uncontrolled case series and more on making studies comparable. Standardized product characterization and treatment reporting, validated clinical and patient-reported outcomes, adequately powered randomized comparisons, and longer safety follow-up would make it easier to identify the facial indications for which PRP offers a meaningful advantage.

5. Influencing Factors of PRP Efficacy

Several patient- and product-related variables may help explain why reported responses to PRP differ across studies.

Age is one possible modifier, although current evidence is preliminary. A single-center ultrasound study reported larger changes in skin density and thickness among younger participants than among older groups [40]. That finding is useful for hypothesis generation, but it does not define a validated age threshold or justify age-specific treatment schedules without confirmation in larger studies.

The way PRP is prepared directly affects the composition of the injected product. Double-spin techniques can produce higher platelet concentrations than single-spin methods, and many facial studies use preparations within an approximate 4 - 6 times baseline range. Leukocyte-poor PRP is often chosen to limit inflammatory exposure, but neither double-spin processing nor any particular leukocyte concentration has been shown to be clinically superior across facial indications. These variables are therefore best treated as reporting parameters rather than proven determinants of efficacy.

Activation also changes how platelet contents are released. Calcium salts and thrombin initiate activation through different mechanisms, while freeze-thaw processing may cause a more abrupt release of intracellular contents. None of these strategies has shown a consistent clinical advantage in facial rejuvenation. Oxygen-enriched PRP produced promising results in one small clinical comparison [16], but the approach remains experimental and requires independent replication.

Treatment schedules are similarly inconsistent. A common pattern is 2 - 4 sessions separated by about 3 - 4 weeks, and some reports suggest maintenance at 6 - 12 months [36]. Repeated treatment is therefore frequent in the literature, but the available evidence does not establish the best number of sessions, interval, or maintenance schedule for a specific indication.

Taken together, differences in patient characteristics and in the composition and delivery of PRP probably account for part of the variability between studies. More consistent reporting and standardized protocols would improve reproducibility and make cross-study comparisons more informative.

6. Research Gaps and Future Directions

The main research gaps arise from the same issues that currently limit interpreta-

tion: inconsistent product characterization, short follow-up, limited mechanistic validation in human tissue, and relatively few direct comparative trials.

Preparation and treatment details need to be reported with enough precision for other investigators to reproduce the intervention. At a minimum, this includes centrifugation force and duration, anticoagulant, platelet and leukocyte counts, activation method, injected volume and depth, treatment interval, and any concomitant procedure. Without these details, the label “PRP” can refer to biologically different products.

Durability and long-term safety are also poorly defined. Most follow-up periods are measured in weeks or months and generally remain within one year. Larger prospective cohorts or registries extending for at least two years would provide better information on persistence of benefit, repeated-treatment exposure, and uncommon adverse outcomes.

Mechanistic work would be stronger if it were linked directly to treated human facial tissue. Studies combining standardized PRP characterization with histology, proteomics, transcriptomics, and validated clinical outcomes could test which proposed growth-factor or extracellular-vesicle pathways are actually active in vivo and whether they track with clinical response.

Patient-level modifiers deserve similar attention. Age, skin phenotype, baseline severity, smoking, sun exposure, and tissue quality may influence response, but the present literature cannot support validated individualized treatment algorithms. Adequately powered trials with prespecified subgroup analyses would be more informative than post hoc observations from small cohorts.

Newer platelet-derived products also require direct comparison with conventional PRP. These include lyophilized PRP, PRP/PRGF gels [2] [19], injectable PRF, and optimized platelet extracts [20] [22]. Their potential advantages in stability, delivery, efficacy, or tolerability should be demonstrated rather than assumed from shared biological origin.

Finally, more head-to-head trials are needed against established alternatives and clearly defined combination comparators. PRP has already been compared with adipose-derived cell products, autologous fat-based treatments, PPP/plasma gel, and other modalities [5] [10] [25], but many comparisons remain small or methodologically heterogeneous. Future studies would be most useful if they combine adequate statistical power with validated objective and patient-reported outcomes and consistent adverse-event reporting.

7. Conclusion

PRP has a credible biological basis for use in facial rejuvenation and appears to be well tolerated in the short term, but the clinical evidence is not equally strong across indications. Selected photoaging and skin-quality outcomes show favorable signals, and comparator-controlled studies support a role for PRP or PRF as an adjunct in some treatments for atrophic acne scarring. Periorbital pigmentary and volume-related results are less consistent; in individual trials, tranexamic acid plus

vitamin C and PPP gel performed better than PRP. Proposed effects on collagen remodeling, angiogenesis, inflammation, pigmentation, and extracellular-vesicle signaling are supported by a mixture of clinical, histologic, and translational evidence, with limited direct pathway confirmation in treated facial tissue. Variation in PRP preparation, small or split-face study designs, non-uniform outcomes, and short follow-up still prevent firm protocol recommendations. Better product characterization, indication-specific randomized comparisons, validated outcomes, and longer safety surveillance are needed to define where PRP provides a clinically meaningful benefit.

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Interpretation Caution

Some of the evidence discussed in this review comes from groups affiliated with BTI Biotechnology Institute. These studies are relevant to the mechanistic and clinical literature, but claims of PRGF superiority remain insufficiently replicated by independent groups. The present review does not endorse a commercial PRP preparation system.

Author Contributions

C.D.P. and K.S.T. independently conducted the literature screening and contributed to the qualitative synthesis and interpretation of the included evidence. J.Z. resolved disagreements during study selection and contributed to the interpretation and critical evaluation of the evidence. All authors critically revised the manuscript for important intellectual content, reviewed the final manuscript, and approved the version submitted for publication.

Conflicts of Interest

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