Indonesian Journal of Global Health Research
Volume 8 Number 6, December 2026
e-ISSN 2715-1972; p-ISSN 2714-9749
http://jurnal.globalhealthsciencegroup.com/index.php/IJGHR

EFFECTIVENESS OF PLATELET-RICH PLASMA ON HAIR REGROWTH IN ANDROGENETIC ALOPECIA: A LITERATURE REVIEW

Agus Ujianto*, Zamsiah Martiasih
Sultan Agung Islamic Hospital, Jl. Kaligawe Raya No.Km. 4, Terboyo Kulon, Genuk, Semarang, Jawa Tengah 50112, Indonesia
*ujiantoagus@gmail.com

ABSTRACT

Platelet-rich plasma (PRP) is a promising therapy for androgenetic alopecia (AGA), but heterogeneous protocols and inconsistent outcomes limit its clinical standardization. A synthesis of recent randomized controlled trials is needed to clarify its effectiveness and support evidence-based practice. Objective to evaluate PRP effectiveness for hair regrowth and assess trial quality. This structured literature review followed PRISMA 2020 guidance. PubMed, Springer, and Google Scholar were searched for studies published from January 2021 to October 2026. Eligible studies were English-language randomized controlled trials involving patients with AGA or female pattern hair loss, comparing autologous PRP with placebo, standard treatment, or alternative PRP protocols and reporting hair-regrowth outcomes. Of 1,946 records identified, 1,022 duplicates and 804 records were removed during screening; 120 full-text reports were assessed, 108 excluded, and 12 trials included. Findings were synthesized narratively, and quality was assessed using Cochrane RoB 2. Twelve trials involving approximately 760 participants showed improved hair density, count, and thickness versus placebo. Adjunctive PRP enhanced standard therapy, whereas comparisons with minoxidil were inconsistent. Nine trials raised some risk-of-bias concerns; three were high risk. PRP appears beneficial as adjunctive AGA therapy, but standardized trials are needed.

Keywords: androgenetic alopecia; hair regrowth; platelet-rich plasma; randomized controlled trial; regenerative medicine

How to cite (in APA style)
Ujianto, A., & Martiasih, Z. (2026). Effectiveness of Platelet-Rich Plasma on Hair Regrowth in Androgenetic Alopecia: A Literature Review. Indonesian Journal of Global Health Research, 8(6), 1439–1450. https://doi.org/10.37287/ijghr.v8i6.3010.

INTRODUCTION

Androgenetic alopecia (AGA), known as male pattern hair loss in men and female pattern hair loss (FPHL) in women, is the most prevalent form of non-scarring alopecia worldwide. It results from a genetically determined hypersensitivity of scalp follicles to androgens, which shortens the anagen phase and progressively miniaturises terminal follicles into vellus-like follicles (Ntshingila et al., 2023). Beyond androgen signalling, recent work has implicated perifollicular micro-inflammation, fibrosis, oxidative stress and impaired follicular energy metabolism in disease progression (Chen et al., 2025). Although AGA is not life-threatening, patterned thinning has a substantial psychosocial burden, particularly among women and younger men, and is associated with reduced self-esteem and quality of life (Oiwoh et al., 2024).

Pharmacological management remains limited. Topical minoxidil and oral finasteride are the only agents with long-standing regulatory approval, and both require indefinite use to maintain benefit (Devjani et al., 2023). Adherence is often poor because of scalp irritation, daily application and concerns about systemic adverse effects of finasteride (Ntshingila et al., 2023), which has stimulated interest in regenerative therapies that act on the follicular microenvironment. Platelet-rich plasma (PRP) is an autologous concentrate of platelets obtained by centrifugation of whole blood. On activation, platelet α-granules release growth factors including platelet-derived growth factor (PDGF), transforming growth factor-β (TGF-β), vascular endothelial growth factor (VEGF) and insulin-like growth factor, which act on dermal papilla cells, endothelial cells and fibroblasts through the PI3K/Akt and MAPK/ERK pathways (Zhang et al., 2025). In hair biology, these

signals are thought to prolong anagen, promote perifollicular angiogenesis, and activate Wnt/β-catenin signalling in the dermal papilla (Qu et al., 2021). AGA is now the most frequently studied indication for regenerative medicine in dermatology, and PRP is the most frequently tested modality for it (Jafarzadeh et al., 2024).

Despite this popularity, several questions remain open. Recent meta-analyses report that PRP improves patient satisfaction but does not clearly surpass minoxidil in hair density (Umar et al., 2026); that preparation variables such as single- versus double-spin centrifugation may influence outcomes (Ghanem et al., 2025); and that PRP combined with minoxidil and growth-factor enrichment may rank among the most effective combinations (Xia et al., 2025). Newer derivatives such as platelet-rich fibrin and stromal vascular fraction are also emerging (Behrangi et al., 2026). Because protocols, comparators and outcomes differ substantially across studies, this literature review aimed to synthesise RCTs published between 2021 and 2026 on the effectiveness of PRP for hair regrowth in AGA, to identify which protocol factors influence response, and to appraise the risk of bias of the available trials.

METHOD

Review Design

This structured literature review of randomized controlled trials was reported with reference to the relevant items of the PRISMA 2020 statement (Page et al., 2021). The review question was framed using the PICO format: Population, adults with AGA or FPHL; Intervention, autologous PRP administered to the scalp by any technique; Comparison, placebo, untreated scalp, standard medical therapy, or an alternative PRP delivery or preparation protocol; and Outcome, objective or clinical measures of hair regrowth.

Search Strategy

PubMed (MEDLINE) was searched for articles published from 1 January 2021 to October 2026. The search combined the terms platelet-rich plasma with androgenetic alopecia, androgenic alopecia, female pattern hair loss or male pattern hair loss, with the Boolean operators AND and OR, and was limited to the publication type Randomized Controlled Trial. MeSH terms were mapped automatically by the database.

Eligibility Criteria

Studies were included if they (a) were RCTs with parallel, split-scalp or half-head designs; (b) enrolled participants with a clinical diagnosis of AGA or FPHL; (c) included at least one arm in which plain autologous PRP was administered; (d) reported at least one hair-regrowth outcome, such as hair count, hair density, shaft diameter, terminal or anagen hair proportion, hair-pull test or standardised global photography; and (e) were published in English between 2021 and 2026. Exclusion criteria are listed in Figure 1.

Study Selection And Data Extraction

Records were screened by title and abstract and then assessed in full against the eligibility criteria. Data on country, design, population, sample size, intervention, comparator, session schedule, outcomes, follow-up and main findings were charted in a review matrix. The literature search identified 1,946 records from PubMed (n = 68), Springer (n = 58), and Google Scholar (n = 1,820). After removing 1,022 duplicates and excluding 804 records during title and abstract screening, 120 full-text articles were assessed for eligibility. Of these, 108 articles were excluded, leaving 12 randomized controlled trials (RCTs) for final analysis. Data on study characteristics, participants, interventions, comparators, treatment protocols, outcomes, and follow-up periods were extracted and summarized in a review matrix.

Risk-Of-Bias Assessment

Methodological quality was appraised with the revised Cochrane risk-of-bias tool for randomized trials, RoB 2 (Sterne et al., 2019). Each trial was rated as low risk, some concerns or high risk in five domains: (D1) the randomization process, (D2) deviations from intended interventions, (D3) missing outcome data, (D4) measurement of the outcome, and (D5) selection of the reported result. The overall judgement followed the RoB 2 algorithm. Judgements were based on the published reports; unreported allocation concealment, blinding or protocol registration was rated as some concerns.

Data Synthesis

Because interventions, comparators, outcome instruments and follow-up periods were heterogeneous, a meta-analysis was not considered appropriate. Findings were synthesised narratively and grouped into five comparison categories: PRP versus placebo or untreated scalp; PRP added to standard therapy; PRP monotherapy versus topical minoxidil; delivery technique; and preparation or biological optimisation.

RESULT

Study Selection

The literature search identified a total of 1,946 records from three databases: PubMed (n = 68), Springer (n = 58), and Google Scholar (n = 1,820). Before screening, 1,022 duplicate records were removed, leaving 924 records for title and abstract screening. Of these, 804 records were excluded because they addressed conditions other than androgenetic alopecia (AGA) or female pattern hair loss (FPHL), including alopecia areata, scarring alopecia, telogen effluvium, chemotherapy-related alopecia, photoaging, and vitiligo.

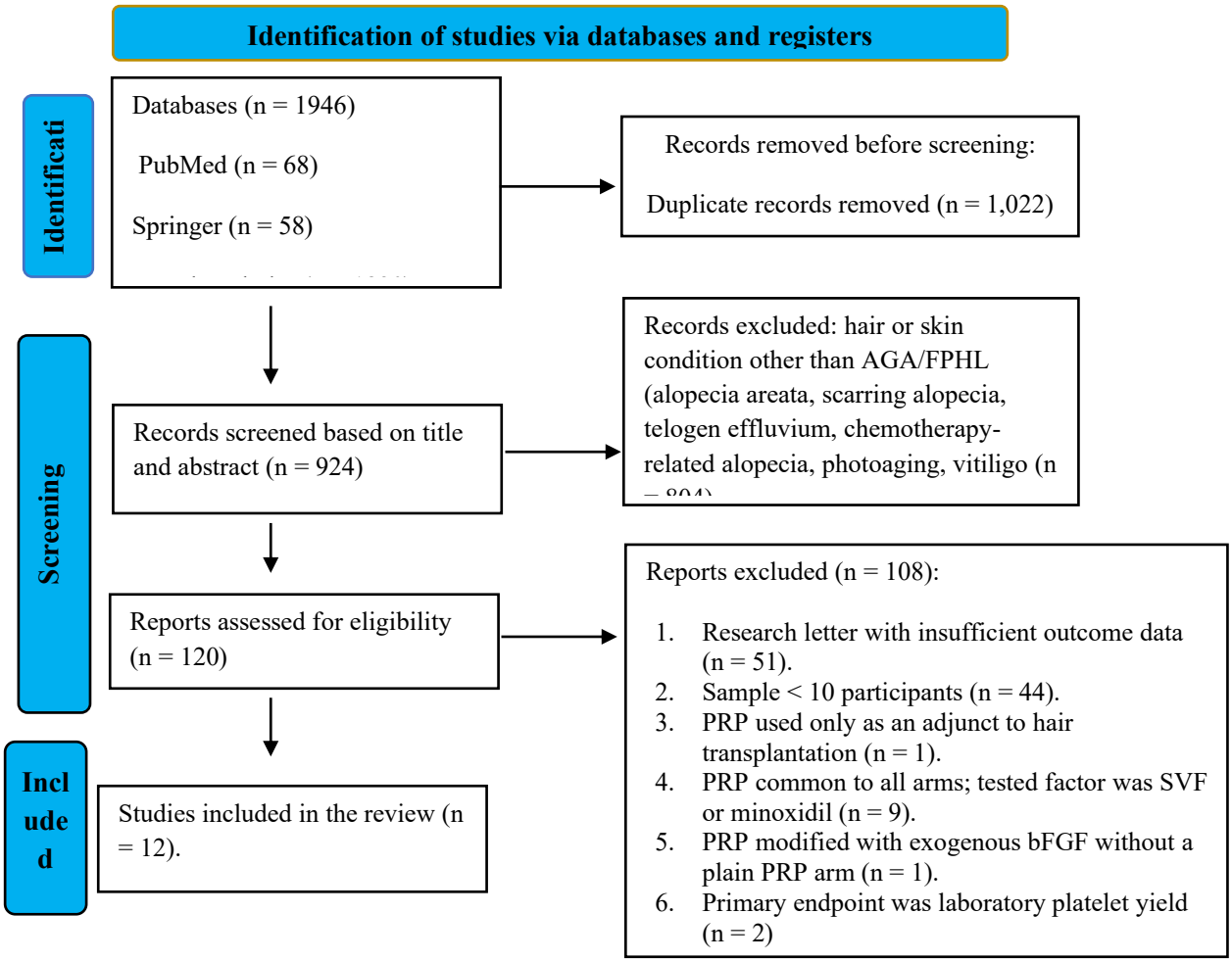


Figure 1. PRISMA flow diagram of article selection.

Following the initial screening, 120 reports were assessed for eligibility. Of these, 108 reports were excluded for the following reasons: insufficient outcome data (n = 51), fewer than 10 participants (n = 44), PRP used only as an adjunct to hair transplantation (n = 1), PRP combined with SVF or minoxidil (n = 9), PRP modified with exogenous bFGF without a plain PRP comparator (n = 1), and primary endpoints based on laboratory platelet yield (n = 2).
Finally, 12 randomized controlled trials (RCTs) met the eligibility criteria and were included in the systematic review, evidence synthesis, and risk-of-bias assessment. The complete study selection process is illustrated in Figure 1.

Characteristics Of The Included Trials

The 12 trials were published between 2021 and 2026 and were conducted in China (n = 4), India (n = 3), Pakistan (n = 2), Egypt (n = 1), Iran (n = 1) and Turkey (n = 1). Together they randomised approximately 760 participants, with sample sizes ranging from 20 to 126. Eight trials used a parallel-group design, and four used within-patient half-head or split-scalp designs (Lu et al., 2025; Qu et al., 2021, 2023; Singh & Singh, 2023). Most trials enrolled both sexes; two enrolled only men (Balasundaram et al., 2023; Ozcan et al., 2022) and one only women with FPHL (Li et al., 2026). PRP was most often given as three to four monthly intradermal sessions, with follow-up ranging from 12 weeks to 8 months. Outcomes were measured objectively by trichoscopy or TrichoScan in most trials, whereas two relied mainly on the hair-pull test and global photography (Afzal et al., 2024; Asim et al., 2023). Table 1 presents the review matrix

Table 1.
Review Matrix Of The Included Randomized Controlled Trials (n = 12)

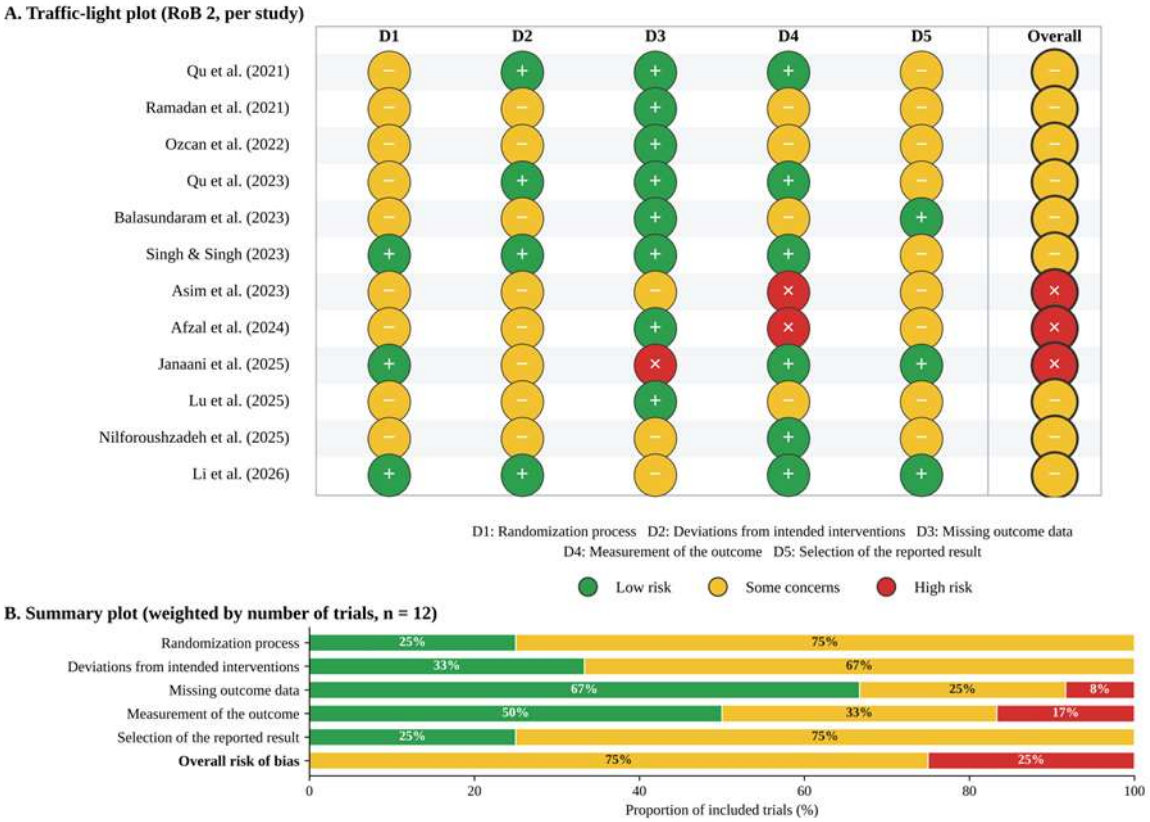
No	Author (Year), Country	Design & Population	N	Intervention Vs Comparator; Protocol	Outcome Measures; Follow-Up	Main Findings On Hair Regrowth
1	Qu et al. (2021), China	Double-blind, placebo-controlled half-head RCT; AGA	52	Intradermal PRP (one half) vs saline (other half)	Hair count, density, diameter, anagen ratio; 6 mo	PRP side superior on all parameters; ↑β-catenin, PDGF, AKT signalling in mice
2	Ramadan et al. (2021), Egypt	Single-blind RCT; AGA	126	Medical therapy + PRP (injection or microneedling) vs medical therapy alone	Hair density, diameter (dermoscopy)	PRP groups gained more density and diameter; best with microneedling
3	Ozcan et al. (2022), Turkey	Parallel RCT; men, Norwood II–V	62	PRP via dermapen vs point-by-point injection; 4 sessions	Hair-pull test; TrichoScan parameters	Both improved count and density; dermapen better for anagen, telogen, length
4	Qu et al. (2023), China	Double-blind, placebo-controlled half-head RCT; men and women	80	PRP + bFGF vs placebo; PRP + bFGF vs plain PRP; 3 monthly sessions	Hair count, terminal, vellus, anagen hair; 6 mo	Plain PRP improved count, terminal and anagen hair; bFGF-PRP > PRP; placebo unchanged
5	Balasundaram et al. (2023) India	Open-label RCT; men, Norwood III–IV	64	PRP monthly × 3 vs 5% topical minoxidil × 6 mo	Global photography (wk 24); hair count, density (wk 12); AEs	Response 38% vs 56% (P = .124); counts rose in both arms, NS between; AEs 53% vs 37%
6	Singh & Singh (2023), India	Double-blind split-head RCT; AGA	80	Activated vs non-activated PRP; platelet-count strata; monthly × 3	Hair density, thickness, photography; 6 mo	Activation and higher platelet count gave greater density and thickness
7	Mehmood Asim & Rohan Shah	Parallel RCT; AGA	72	PRP vs 5% topical	Hair-pull test; 12 wk	Negative pull test 91.7% (PRP) vs

No	Author (Year), Country	Design & Population	N	Intervention Vs Comparator; Protocol	Outcome Measures; Follow-Up	Main Findings On Hair Regrowth
	(n.d.) , Pakistan			minoxidil		69.4% (minoxidil)
8	Afzal et al. (2024), Pakistan	Parallel RCT; adults 18–60 y	70	PRP vs 5% topical minoxidil	Global photography, pull test, satisfaction; 6 mo	Negative pull test 40% vs 77% (P = .001), yet overall response 74.5% vs 43.7% (inconsistent)
9	Janaani et al. (2025), India	Observer-blinded three-arm RCT; AGA	75 (60 completed)	PRP + topical minoxidil vs oral minoxidil vs topical minoxidil	Terminal/vellus density, severity grade; 32 wk	Terminal density gain 57% vs 47.5% and 48% (P = .03, .02); grade similar
10	Lu et al. (2025), China	Split-scalp RCT; AGA	20	PRP via microneedle vs intradermal injection; 3 monthly sessions	Density, diameter, pain (NRS); 6 mo post	No difference in regrowth; microneedle less painful (P < .001)
11	Nilforoushzadeh et al. (2025) , Iran	Phase I parallel RCT; adults 18–50 y	40	PRP injection vs PRP microneedling; 2 sessions	Hair count, thickness (TrichoScan); 2 mo post	Count +62.4% vs +88.4%; thickness +58.6% vs +51.3%; NS between
12	Li et al. (2026), China	Multicentre three-arm RCT; women with FPHL	74 completed	PRP vs i-PRF vs CGF; 4 sessions, 4-weekly	Target-area hair count, diameter; 24 wk	Hair-count gain 14.5% (PRP) vs 26.5% (i-PRF) and 27.1% (CGF), P < .05

Note. AE = adverse event; AGA = androgenetic alopecia; bFGF = basic fibroblast growth factor; CGF = concentrated growth factors; FPHL = female pattern hair loss; i-PRF = injectable platelet-rich fibrin; mo = months; NRS = numerical rating scale; NS = not significant between groups; PRP = platelet-rich plasma; RCT = randomized controlled trial; wk = weeks.

Risk of bias

No trial was judged to be at low overall risk of bias (Figure 2). Nine trials were rated as some concerns and three as high risk. The most frequent sources of concern were insufficient reporting of random sequence generation and allocation concealment (D1, 75% of trials) and the absence of a preregistered protocol or statistical analysis plan (D5, 75%). Blinding of participants was rarely feasible when PRP was compared with a topical drug or another device (D2). Two trials were rated at high risk in the measurement domain because their main outcomes, the hair-pull test and global improvement, were assessed by unblinded investigators (Afzal et al., 2024; Asim et al., 2023). Afzal et al. (2024) also reported internally inconsistent efficacy results. One trial was rated at high risk for missing outcome data because 20% of randomised participants did not complete follow-up and analysis was restricted to completers (Janaani et al., 2025). The placebo-controlled and double-blind split-head trials were at low risk in D4 (Qu et al., 2021, 2023; Singh & Singh, 2023).



Note. Green (+) = low risk; yellow (−) = some concerns; red (×) = high risk. D1 = randomization process; D2 = deviations from intended interventions; D3 = missing outcome data; D4 = measurement of the outcome; D5 = selection of the reported result.

Figure 2. Risk-of-bias assessment of the included randomized controlled trials using RoB 2: (A) traffic-light plot and (B) summary plot

Effectiveness Of PRP By Type Of Comparison

PRP versus placebo or untreated scalp. Two double-blind, placebo-controlled half-head trials provided the most direct evidence of efficacy. In 52 patients, the PRP-treated side showed significantly greater hair count, hair density, shaft diameter and anagen ratio than the saline-treated side at six months (Qu et al., 2021). In a parallel mouse model, the same study showed up-regulation of β-catenin, PDGF and AKT signalling and suppression of p53 signalling, supporting a biological basis for the clinical effect. In 80 patients, plain PRP likewise increased hair count, terminal hair and anagen hair, whereas the placebo side showed no significant change on any parameter (Qu et al., 2023).

PRP added to standard therapy. Two trials examined PRP as an adjunct. Adding PRP to combined medical therapy produced significantly greater increases in hair density and diameter than medical therapy alone, and the gains were larger and faster when PRP was delivered by microneedling (Ramadan et al., 2021). In a three-arm, observer-blinded trial, PRP combined with topical minoxidil achieved the largest median increase in terminal hair density at 32 weeks (57%), significantly more than low-dose oral minoxidil (47.5%) or topical minoxidil alone (48%) (Janaani et al., 2025). Improvement in overall clinical severity grade did not differ between arms, however, which suggests that density gains may precede visible cosmetic change.

PRP monotherapy versus topical minoxidil. Three trials compared PRP with 5% topical minoxidil and reached divergent conclusions. In an open-label trial of 64 men with moderate AGA, the global photographic response at week 24 was 38% with PRP and 56% with minoxidil (P = .124). Hair counts increased within both groups without a between-group difference, and adverse events and dissatisfaction were more common with PRP (Balasundaram et al., 2023). Asim et al. (2023)

reported a higher rate of negative hair-pull tests with PRP (91.7% vs. 69.4%) after 12 weeks. Conversely, Afzal et al. (2024) found more negative hair-pull tests with minoxidil (77% vs. 40%) while also reporting a higher overall response with PRP. Because the two trials favouring PRP relied on unblinded, semi-quantitative outcomes and were at high risk of bias, this body of evidence does not establish PRP as superior to minoxidil.

Delivery technique. Three trials compared microneedle-assisted delivery with conventional needle injection. In a split-scalp trial, no significant differences were found in hair density, shaft diameter or follicular-unit composition six months after treatment, but pain scores were markedly lower with microneedle delivery ($P < .001$) (Lu et al., 2025). Nilforoushzadeh et al. (2025) observed within-group increases in hair count of 62.4% with injection and 88.4% with microneedling, with no significant difference between techniques. Ozcan et al. (2022) reported comparable gains in hair count and density with both methods and a significant advantage of dermapen delivery in anagen and telogen proportions and hair length.

Preparation and biological optimisation. Three trials showed that the biological composition of the injectate influences response. In a double-blind split-head trial, calcium-activated PRP produced greater gains in density and thickness than non-activated PRP, and hair density and thickness increased in a dose-dependent manner across platelet-count strata (Singh & Singh, 2023). Enriching PRP with basic fibroblast growth factor improved hair count, terminal, vellus and anagen hair more than plain PRP (Qu et al., 2023). In women with FPHL, injectable platelet-rich fibrin (i-PRF) and concentrated growth factors (CGF) nearly doubled the increase in non-vellus target-area hair count compared with PRP (26.5% and 27.1% vs. 14.5%), and VEGF concentration correlated positively with regrowth (Li et al., 2026). Table 2 summarises the evidence by comparison.

Table 2.
Summary of evidence by type of comparison

Comparison	Trials (n participants)	Direction and consistency of effect on hair regrowth
PRP vs placebo / untreated half-scalp	Qu 2021; Qu 2023 (n = 132)	Consistent benefit: PRP increased hair count, density, diameter and anagen proportion, whereas saline produced no measurable change
PRP added to standard therapy vs standard therapy alone	Ramadan 2021; Janaani 2025 (n = 201)	Consistent additive benefit in terminal hair density and shaft diameter; global severity grade not significantly different
PRP monotherapy vs 5% topical minoxidil	Balasundaram 2023; Asim 2023; Afzal 2024 (n = 206)	Inconsistent: one trial favoured PRP, one favoured minoxidil on the hair-pull test, and the trial with objective counts found no difference
Delivery technique (microneedling vs needle injection)	Ozcan 2022; Lu 2025; Nilforoushzadeh 2025 (n = 122)	Comparable regrowth; microneedling equal or better for some parameters and consistently less painful
Preparation and biological optimisation	Singh 2023; Qu 2023; Li 2026 (n = 234)	Activation, higher platelet dose, bFGF enrichment and fibrin-based concentrates (i-PRF, CGF) enhanced regrowth relative to standard PRP

Note. Participant numbers are those randomised or analysed as reported; Qu et al. (2023) contributes to two comparison categories. RoB = risk of bias (RoB 2).

Safety And Tolerability

PRP was well tolerated across trials, and no serious adverse events were reported. The most common events were transient injection pain, pinpoint bleeding, scalp tenderness and occasional dizziness during venepuncture or injection (Janaani et al., 2025). Adverse events were more frequent with PRP than with topical minoxidil in one trial (53% vs. 37%) (Balasundaram et al., 2023). Microneedle delivery substantially reduced procedural pain (Lu et al., 2025; Nilforoushzadeh et al., 2025), and i-PRF had the lowest adverse event rate among the platelet concentrates compared in women (Li et al., 2026).

DISCUSSION

This review of 12 RCTs published between 2021 and 2026 shows that PRP reliably stimulates hair regrowth in AGA when compared with placebo or untreated scalp, and that it adds measurable benefit when combined with conventional medical therapy. The strongest evidence comes from the double-blind, placebo-controlled half-head trials, in which hair count, density, shaft diameter and anagen proportion improved only on the PRP-treated side (Qu et al., 2021, 2023). These findings agree with the broader dermatology literature, which identifies PRP as the most extensively investigated regenerative intervention for AGA (Jafarzadeh et al., 2024).

Whether PRP can replace minoxidil remains uncertain. The three head-to-head trials in this review were inconsistent, and the most methodologically robust of them, with objective hair counts, found no significant difference between treatments (Balasundaram et al., 2023). This pattern mirrors a recent meta-analysis of nine RCTs, which found that PRP improved patient satisfaction and hair-pull results but did not outperform minoxidil in hair density, terminal hair count or moderate-to-high regrowth (Umar et al., 2026). The more consistent finding is that combination therapy is superior to either treatment alone (Janaani et al., 2025; Ramadan et al., 2021). This is consistent with a network meta-analysis in which PRP combined with basic fibroblast growth factor and minoxidil ranked highest among minoxidil-based regimens (Xia et al., 2025). Clinically, PRP is therefore best positioned as an adjunct that augments standard therapy, rather than as a stand-alone alternative.

The review also highlights that "PRP" is not a single, uniform product. Platelet concentration, activation status, leukocyte content, centrifugation protocol and growth-factor profile all vary between systems, and several included trials showed that these variables change clinical outcomes (Li et al., 2026; Singh & Singh, 2023). The dose-response relationship with platelet count and the positive correlation between VEGF concentration and regrowth support the biological rationale that growth factors drive follicular recovery (Zhang et al., 2025). They also explain part of the heterogeneity across studies. A meta-analysis likewise found that centrifugation protocol matters, without a definitive advantage for double-spin preparation (Ghanem et al., 2025). Fibrin-based concentrates and cell-based products such as stromal vascular fraction appear to produce faster or larger responses (Behrangi et al., 2026; Li et al., 2026), suggesting that conventional PRP may be overtaken by these newer derivatives.

Patient-centred outcomes deserve more attention. Pain during multiple scalp injections is a recognised barrier to completing PRP courses. Microneedle delivery achieved comparable regrowth with significantly less pain and higher satisfaction (Lu et al., 2025; Nilforoushzadeh et al., 2025), making it a practical option for improving tolerability and adherence. For nurses and other clinicians who prepare and administer PRP, the findings suggest several practice priorities: standardising preparation steps and documenting platelet yield; using pain-reducing delivery techniques; educating patients that cosmetic change may lag behind measurable density gains and that maintenance sessions are usually required; and monitoring for vasovagal reactions and local adverse effects.

Strengths And Limitations

This review was restricted to randomized trials, applied RoB 2 to every study and grouped evidence by clinically meaningful comparisons. Several limitations apply. The search was limited to a single database and to English-language publications, so relevant trials indexed elsewhere may have been missed. Risk-of-bias judgements were based on published reports, and incomplete reporting may have led to more conservative ratings than the trials' actual conduct deserves. The included trials were small, most followed participants for six months or less, and outcome instruments ranged from automated phototrichograms to semi-quantitative hair-pull tests, which limits comparability.

CONCLUSION

Recent randomized evidence shows that platelet-rich plasma promotes hair regrowth in androgenetic alopecia compared with placebo and enhances the effect of standard medical therapy, with a favourable safety profile. Evidence that PRP monotherapy is superior to topical minoxidil is inconsistent. Treatment response depends on how PRP is prepared and delivered: higher platelet dose, activation, growth-factor enrichment and microneedle-assisted delivery are associated with better outcomes or tolerability.

REFERENCES

Afzal, G., Ahmed, N., Zahoor, F., Malik, T., & Farooq. (2024). Efficacy of Platelet-Rich Plasma versus 5% Topical Monixidil for the Treatment of Androgenetic Alopecia. *Journal of the College of Physicians and Surgeons Pakistan*, *34*(01), 11–15. https://doi.org/10.29271/jcpsp.2024.01.11

Balasundaram, M., Kumari, R., & Ramassamy, S. (2023). Efficacy of autologous platelet-rich plasma therapy versus topical Minoxidil in men with moderate androgenetic alopecia: a randomized open-label trial. *Journal of Dermatological Treatment*, *34*(1). https://doi.org/10.1080/09546634.2023.2182618

Behrangi, E., Amiri, S., Zeinali, R., Goodarzi, A., Roohaninasab, M., Khosravi, M., & Jafarzadeh, A. (2026). A systematic review of clinical evidence on the efficacy and safety of conditioned media, platelet-rich fibrin, stromal vascular fraction, extracellular vesicles, and stem cells in androgenetic alopecia. *Stem Cell Research & Therapy*, *17*(1), 194. https://doi.org/10.1186/s13287-026-05016-2

Chen, S., Li, L., Ding, W., Zhu, Y., & Zhou, N. (2025). Androgenetic Alopecia: An Update on Pathogenesis and Pharmacological Treatment. *Drug Design, Development and Therapy*, *Volume 19*, 7349–7363. https://doi.org/10.2147/DDDT.S542000

Devjani, S., Ezemma, O., Kelley, K. J., Stratton, E., & Senna, M. (2023). Androgenetic Alopecia: Therapy Update. *Drugs*, *83*(8), 701–715. https://doi.org/10.1007/s40265-023-01880-x

Ghanem, L., Kirmani, N., Palacios-Ortiz, M. P., Cevallos-Cueva, M., Mendoza-Millán, D. L., Almeida Nascimento, G. V., & Velasco-Tamariz, V. (2025). Comparison of single-spin to double-spin platelet-rich plasma centrifugation methods in the treatment of androgenic alopecia: a systematic review and meta-analysis of randomized controlled trials. *Frontiers in Medicine*, *12*. https://doi.org/10.3389/fmed.2025.1631087

Jafarzadeh, A., Pour Mohammad, A., Keramati, H., Zeinali, R., Khosravi, M., & Goodarzi, A. (2024). Regenerative medicine in the treatment of specific dermatologic disorders: a systematic review of randomized controlled clinical trials. *Stem Cell Research & Therapy*, *15*(1), 176. https://doi.org/10.1186/s13287-024-03800-6

Li, M., Bai, Y., Ye, Z., Zhang, D., He, Z., Ge, Z., Tan, A., Han, Y., Chen, A., Wang, W., & Zhuo, F. (2026). Comparative efficacy and safety of platelet-rich plasma (PRP), injectable platelet-rich fibrin (i-PRF) and concentrated growth factors (CGF) for female pattern hair loss (FPHL): a prospective multicenter randomized clinical trial. *Journal of Dermatological Treatment*, *37*(1). https://doi.org/10.1080/09546634.2026.2659498

Lu, P., Liao, M., Qiu, X., Xiang, Y., Xu, Y., Ye, X., Zeng, Z., Li, L., & You, C. (2025). Platelet-rich plasma for androgenetic alopecia: intradermal injection or microneedle delivery? *Journal of Cosmetic and Laser Therapy*, *27*(3), 53–63. https://doi.org/10.1080/14764172.2025.2488980

Mehmood Asim, & Rohan Shah, S. S. S. O. A. S. B. R. (n.d.). *A Randomized Control Trial Comparing the Efficacy of Platelet-Rich Plasma and 5% Topical Minoxidil for the Treatment of Androgenetic Alopecia*.

Nilforoushzadeh, M. A., Roohaninasab, M., Behrangi, E., Jafarzadeh, A., Nouri, M., Zare, S., & Zare, S. (2025). Phase I Clinical Trial: Evaluating the Efficacy, Safety, and Patient Satisfaction of Platelet-Rich Plasma (PRP) Injections and Microneedling for Androgenetic

Alopecia Treatment. *Journal of Cosmetic Dermatology*, *24*(9). https://doi.org/10.1111/jocd.70408

Ntshingila, S., Oputu, O., Arowolo, A. T., & Khumalo, N. P. (2023). Androgenetic alopecia: An update. *JAAD International*, *13*, 150–158. https://doi.org/10.1016/j.jdin.2023.07.005

Oiwoh, S. O., Enitan, A. O., Adegbosin, O. T., Akinboro, A. O., & Onayemi, E. O. (2024). Androgenetic Alopecia: A Review. *Nigerian Postgraduate Medical Journal*, *31*(2), 85–92. https://doi.org/10.4103/npmj.npmj_47_24

Ozcan, K. N., Sener, S., Altunisik, N., & Turkmen, D. (2022). <scp>P</scp> latelet rich plasma application by dermapen microneedling and intradermal point-by-point injection methods, and their comparison with clinical findings and trichoscan in patients with androgenetic alopecia. *Dermatologic Therapy*, *35*(1). https://doi.org/10.1111/dth.15182

Page, M. J., McKenzie, J. E., Bossuyt, P. M., Boutron, I., Hoffmann, T. C., Mulrow, C. D., Shamseer, L., Tetzlaff, J. M., Akl, E. A., Brennan, S. E., Chou, R., Glanville, J., Grimshaw, J. M., Hróbjartsson, A., Lalu, M. M., Li, T., Loder, E. W., Mayo-Wilson, E., McDonald, S., … Moher, D. (2021). The PRISMA 2020 statement: an updated guideline for reporting systematic reviews. *BMJ*, n71. https://doi.org/10.1136/bmj.n71

Qu, Q., He, Y., Guo, Z., Sun, Y., Fan, Z., Yi, Y., Zhu, D., Hu, Z., & Miao, Y. (2023). Efficacy of Platelet-Rich Plasma plus Basic Fibroblast Growth Factor on the Treatment of Androgenic Alopecia. *Plastic & Reconstructive Surgery*, *151*(4), 630e–640e. https://doi.org/10.1097/PRS.0000000000010000

Qu, Q., Zhou, Y., Shi, P., Du, L., Fan, Z., Wang, J., Li, X., Chen, J., Zhu, D., Ye, K., Hu, Z., & Miao, Y. (2021). Platelet-rich plasma for androgenic alopecia: A randomized, placebo-controlled, double-blind study and combined mice model experiment. *Journal of Cosmetic Dermatology*, *20*(10), 3227–3235. https://doi.org/10.1111/jocd.14089

Ramadan, W. M., Hassan, A. M., Ismail, M. A., & El Attar, Y. A. (2021). Evaluation of adding platelet-rich plasma to combined medical therapy in androgenetic alopecia. *Journal of Cosmetic Dermatology*, *20*(5), 1427–1434. https://doi.org/10.1111/jocd.13935

Singh, S. K., & Singh, S. (2023). Effect of platelet counts and activator in platelet-rich plasma on the treatment of androgenetic alopecia, split-head comparison: A randomised, double-blind study. *Indian Journal of Dermatology, Venereology and Leprology*, *89*, 647. https://doi.org/10.25259/IJDVL_1254_20

Sterne, J. A. C., Savović, J., Page, M. J., Elbers, R. G., Blencowe, N. S., Boutron, I., Cates, C. J., Cheng, H.-Y., Corbett, M. S., Eldridge, S. M., Emberson, J. R., Hernán, M. A., Hopewell, S., Hróbjartsson, A., Junqueira, D. R., Jüni, P., Kirkham, J. J., Lasserson, T., Li, T., … Higgins, J. P. T. (2019). RoB 2: a revised tool for assessing risk of bias in randomised trials. *BMJ*, l4898. https://doi.org/10.1136/bmj.l4898

Umar, M., Anwar, A., Shamim, L., Ahmad, O., Laique, F., Mohiuddin, M., Hidayat, A., & Baig, M. M. A. (2026). Comparative Efficacy and Safety of Platelet Rich Plasma (PRP) versus Topical Minoxidil for Androgenetic Alopecia: A Systematic Review and Meta-analysis. *Aesthetic Plastic Surgery*, *50*(3), 1340–1353. https://doi.org/10.1007/s00266-025-05394-7

Xia, Y., Chen, H., Chen, Y., & Chen, Z. (2025). Relative efficacy of minoxidil in combination with other treatments for androgenic alopecia: a network meta-analysis based on randomized controlled trials. *Frontiers in Medicine*, *12*. https://doi.org/10.3389/fmed.2025.1638496

Zhang, G., Song, Y., Zhuang, T., Zhao, Y., Pan, Z., & Pan, Z. (2025). Clinical application and research progress of platelet-rich plasma. *Hematology*, *30*(1). https://doi.org/10.1080/16078454.2025.2549159