Platelet-Rich Plasma as a Novel Treatment for Hair Loss: A Systematic Review of Safety, Efficacy, and Patient Outcomes

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Abstract

Hair loss is common and clinically heterogeneous, and platelet-rich plasma (PRP) has emerged as a minimally invasive autologous therapy with potential effects on follicular cycling and the scalp microenvironment. This review evaluated PRP safety, efficacy, and patient outcomes across hair-loss conditions.

Methods:
PRISMA-guided systematic review and meta-analysis was conducted using PubMed, Embase, and Scopus (inception to 10 February 2026). Human clinical studies with extractable quantitative data on PRP for hair loss were included. Primary outcomes were hair density, hair thickness, hair count, and pulled hair number; safety and patient-reported outcomes were summarized. Risk of bias was assessed using ROBINS-I, and random-effects models were applied for pooling.

Result:
Eight studies met inclusion criteria. PRP was generally well tolerated, with mostly mild, transient procedure-related adverse events (e.g., injection-site pain, erythema/edema, pruritus, bruising) and no consistent signal of serious complications, although safety reporting was variable. Meta-analysis showed PRP increased hair density (pooled SMD = 3.39, 95% CI 2.27–4.52) and hair thickness (pooled SMD = 2.78, 95% CI 1.91–3.65) versus control, and reduced pulled hair number (pooled SMD = −3.75, 95% CI −5.59 to −1.92). Hair count was not clearly different from control (pooled SMD = −0.95, 95% CI −17.87 to 15.96). Most studies were at low-to-moderate risk of bias, with one at serious risk.

Conclusions:
PRP may improve hair density and thickness and reduce shedding-related measures in selected patients, but effects on hair count remain uncertain and outcomes are sensitive to protocol variability. Larger standardized randomized trials with longer follow-up are needed.

Background:

Introduction

Hair loss is a highly prevalent, clinically heterogeneous complaint that ranges from patterned miniaturization in androgenetic alopecia (AGA) to immune-mediated shedding in alopecia areata (AA), with substantial psychosocial and quality-of-life impact.[1] Epidemiologically, AGA is often cited as affecting up to 50% of males and females after puberty, making it one of the most common chronic hair disorders encountered in dermatology practice.[2] In contrast, AA carries a notable lifetime incidence on the order of 2.1% in large

population-based data, underscoring that both scarring and nonscarring alopecias contribute meaningfully to overall disease burden.[3] Clinically, treatment response is typically monitored using objective, reproducible endpoints, particularly hair density (hairs/cm²), hair thickness/diameter, hair count, and standardized shedding assessments such as the hair pull test (e.g., pulled hair number), because these metrics align with follicular unit function and are sensitive to change over time.[3]

Despite established options (e.g., topical minoxidil, oral 5-α reductase inhibitors for AGA, and immunomodulatory approaches for AA), real-world outcomes are often constrained by adherence demands, tolerability concerns, contraindications, and variable response.[4] As a result, interest has grown in regenerative and autologous approaches that may complement or reduce dependence on long-term pharmacotherapy. Platelet-rich plasma (PRP) has emerged as a candidate "biologic" treatment because it is derived from the patient's own blood and is enriched with platelets that release growth factors and signaling mediators implicated in follicular cycling, angiogenesis, and inflammation modulation.[5] Delivered via intradermal/subdermal scalp injections, PRP is positioned clinically as a minimally invasive, office-based intervention with a mechanistic rationale that plausibly targets both miniaturization (via anagen support) and inflammatory microenvironments that can exacerbate shedding.[5–7]

However, the clinical literature remains mixed in quality and highly variable in PRP preparation, injection protocols, number of sessions, and outcome assessment methods, factors that complicate translation into standardized care pathways. From a safety perspective, controlled trial data indicate mostly transient local effects; in one placebo-controlled pilot study, pain during treatment was commonly mild–moderate and severe pain was uncommon, with no serious adverse events reported.[8] Given these uncertainties and the growing use of PRP in clinical practice, this systematic review evaluates PRP as a novel treatment for hair loss by synthesizing evidence on safety, efficacy, and patient outcomes, with a specific focus on clinically actionable endpoints: hair density, hair thickness, hair count, and pulled hair number.

Material And Methods

Study design and reporting framework

This review was planned as a systematic review and meta-analysis and was reported in accordance with the PRISMA 2020 guideline and checklist to ensure transparent, complete, and reproducible reporting of the methods and findings.[9]

Clinical question and analytic framework

The population of interest comprised individuals of any age or sex with clinically diagnosed hair loss or alopecia of any etiology managed in clinical settings. The intervention was autologous PRP delivered for hair loss, without restricting eligibility based on preparation method, activation strategy, injection technique, dosing schedule, or number of treatment sessions. Eligible comparators included placebo or sham procedures, no treatment, standard medical therapy, other procedural therapies, and within-person baseline comparisons in pre–post designs when parallel comparators were unavailable. Outcomes were defined a priori, with efficacy evaluated primarily using hair density, hair thickness, hair count, and pulled hair number; safety evaluated through local and systemic adverse events, tolerability, and withdrawals attributable to adverse events; and patient outcomes evaluated secondarily through patient satisfaction and other patient-reported outcomes, including quality-of-life instruments when reported.

Eligibility criteria

Studies were eligible if they were human clinical investigations evaluating PRP for hair loss and if they provided extractable quantitative data for at least one prespecified outcome. Comparative designs, whether randomized or non-randomized, were included, as were single-arm pre–post studies provided that

outcome data could be quantified. To align inclusion with the review objectives, studies had to report at least one of the primary efficacy outcomes or provide safety or patient-reported outcome data relevant to PRP treatment. Studies were excluded if they were animal or in vitro investigations, biomechanical studies, or purely laboratory work. Narrative reviews, editorials, commentaries, protocols that did not contribute usable methodological details, and conference abstracts lacking sufficient extractable data were also excluded. When multiple reports described the same cohort, the most complete and/or most recent dataset was retained to avoid double counting.

Information sources and search strategy

A comprehensive literature search was conducted in PubMed, Embase, and Scopus from database inception through 10 February 2026. Search strategies combined controlled vocabulary, when available, with free-text keywords capturing PRP and hair loss or alopecia, including terms such as platelet-rich plasma, PRP, hair loss, alopecia, and androgenetic alopecia, with database-specific syntax adapted to each platform. To further enhance completeness, reference lists of included studies and relevant reviews were screened for additional eligible records.

Study selection process

After retrieval, records were deduplicated and were evaluated in a two-stage screening process consisting of title and abstract screening followed by full-text assessment for final eligibility. Screening was conducted independently by all authors, and any disagreements at either stage were resolved through discussion until consensus was achieved. The selection process was documented using a PRISMA flow diagram detailing the numbers of records identified, screened, excluded with reasons, and included in the qualitative and quantitative syntheses.

Data extraction and data items

Data extraction was performed independently by all authors using a standardized extraction form to promote consistency and reduce errors, with discrepancies resolved through discussion. Extracted study characteristics included author, year, country, study design, setting, and duration of follow-up. Participant data included sample size, age, sex distribution, diagnosis or type of hair loss, and baseline severity where reported. Intervention details captured PRP preparation and delivery characteristics to the extent described, including centrifugation or preparation approach, reporting of platelet concentration, activation strategy, injection method, treatment frequency and number of sessions, and concomitant therapies. Comparator characteristics were recorded when applicable. Outcome extraction captured measurement methods and time points for hair density, hair thickness, hair count, and pulled hair number, as well as adverse events, withdrawals due to adverse events, and patient satisfaction or other patient-reported outcome instruments when available. When quantitative outcome data were missing, unclear, or not presented in extractable form, corresponding authors were contacted to request clarification or additional data.

Risk of bias assessment

Risk of bias was assessed using the ROBINS-I tool, applied at the outcome level where feasible. This assessment considered bias due to confounding, participant selection, classification of interventions, deviations from intended interventions, missing data, outcome measurement, and selective reporting. Each outcome received an overall judgment categorized as low, moderate, serious, or critical risk of bias, or no information when the evidence was insufficient to judge. Assessments were conducted independently by all authors, with disagreements resolved through discussion to reach consensus.

Data synthesis and statistical analysis

For continuous outcomes such as hair density, hair thickness, hair count, and pulled hair number, effect sizes will be synthesized using standardized mean differences, with small-sample correction applied when appropriate to improve

comparability across scales and study sizes. For dichotomous outcomes, including the occurrence of adverse events and withdrawals attributable to adverse events, risk ratios will be used. When at least two studies are sufficiently comparable from clinical and methodological perspectives, meta-analysis will be undertaken using a random-effects model to account for between-study heterogeneity. Risk ratios will be pooled using Mantel–Haenszel methods within a random-effects framework when appropriate, while standardized mean differences will be pooled using inverse-variance methods with Wald-type inference and estimators selected to match the underlying data structure.

Assessment and exploration of heterogeneity

Heterogeneity will be quantified and interpreted using Cochran's Q, I^2, and τ^2. Where heterogeneity is observed, potential explanations will be explored through careful qualitative assessment of differences in populations, PRP protocols, comparators, follow-up timing, and outcome measurement approaches. When the number of studies and reporting completeness permit, quantitative exploration will be undertaken through subgroup analyses or meta-regression, recognizing that these approaches require adequate statistical power and consistent reporting to yield meaningful inferences.

Small-study effects and publication bias

When sufficient studies are available for a given outcome, commonly at least ten, small-study effects will be assessed using funnel plots and statistical tests for funnel plot asymmetry, such as Egger-type methods, when appropriate for the data. Forest plots will be generated for each meta-analyzed outcome, and funnel plots will be produced when the number of included studies supports meaningful interpretation.

Software and analytic environment

All analyses will be conducted in R using the RStudio IDE maintained by Posit. Meta-analyses and visualizations will be implemented using established R packages, including meta and metafor, and figures such as forest and funnel plots will be generated using plotting functions available within these packages.

Result

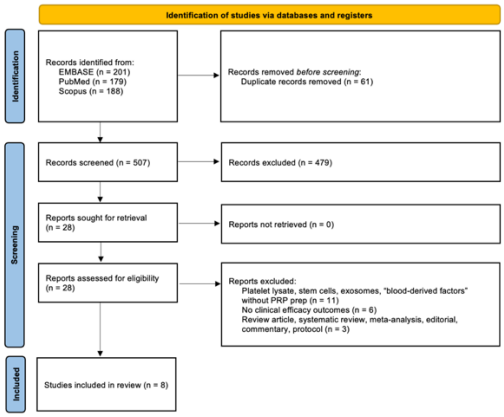

Figure 1. PRISMA flow chart.

Safety

Across included studies, PRP was generally well tolerated, with adverse events primarily limited to short-lived, procedure-related effects. Reported reactions were typically mild and self-limiting, including injection-site pain, scalp tenderness, transient erythema or edema, pruritus, and occasional bruising. When described, these events resolved within hours to a few days and rarely required treatment. Importantly, serious complications were not a prominent feature of the available clinical literature; however, safety reporting was inconsistent across trials, which limits confidence in estimating the true frequency of uncommon events. For publication-quality synthesis, these findings support PRP as having a favorable short-term tolerability profile, while highlighting the need for standardized adverse-event collection and reporting.

Efficacy

Efficacy findings were heterogeneous across hair-loss subtypes and study designs. In AGA/FPHL, three recurring patterns emerged: (1) within-group improvements were common suggesting meaningful contributions from scalp microinjection effects, concomitant

therapies, and natural variation in disease course; (2) several studies demonstrated clinically and statistically meaningful between-group advantages favoring PRP for objective measures such as hair density/count and global photographic assessments, particularly at mid-term follow-up (approximately six months); and (3) other trials showed no objective superiority versus placebo or established therapies (e.g., topical minoxidil), indicating that PRP is not uniformly effective and that observed benefit may be moderate and context dependent. Collectively, these data suggest PRP can improve objective hair parameters in some patients, but its comparative effectiveness appears sensitive to patient selection and protocol parameters.

Patient Outcomes

Patient-reported outcomes generally aligned with clinical trends, with many studies noting improvements in perceived hair quality and satisfaction, although measurement approaches were variable and often non-standardized. In alopecia areata, the evidence supports PRP as a potential adjunct or alternative when intralesional corticosteroids are poorly tolerated or contraindicated, rather than as a consistent first-line replacement; comparative studies frequently report regrowth with PRP but often less than steroid injections, and some suggest differences in relapse or tolerability rather than clear efficacy superiority. For chronic telogen effluvium, early controlled data indicate improvements in trichoscopic measures and patient-reported shedding outcomes compared with placebo, but the evidence base remains limited. For scarring alopecias, the literature is insufficient to support PRP as a substitute for immunomodulatory standard-of-care; current data primarily motivate future trials designed around disease-activity endpoints (symptoms, inflammatory signs, and progression) alongside hair metrics and quality-of-life measures

Table 1. Demographic characteristics of included studies.

Study ID	Sample Size (N)	Age (Years)	Condition Treated	Severity Scale
Dubin et al. (2020)	N=30 (15 PRP, 15 Placebo)	PRP: Mean 47 (Range 28–70); Placebo: Mean 53 (Range 27–85)	Androgenetic Alopecia (AGA)	Ludwig I–III
Bruce et al. (2020)	N=20 enrolled *(19 PRP analyzed; 18 Minoxidil analyzed)*	Adult females (≥18)	Androgenetic Alopecia (AGA)	Ludwig I–II
Agarwal & Mendiratta (2023)	N=26 (12 PRP+Minoxidil, 14 Minoxidil)	Group 1: 83.3% aged 18–32; Group 2: 64.3% aged 32–53	Female Pattern Hair Loss (FPHL)	Ludwig I–III
Tawfik & Osman (2018)	N=30 (Split-scalp, placebo-controlled)	Mean 29.3 ± 6.56 (Range 20–45)	Female Pattern Hair Loss (FPHL)	Ludwig I–III
Puig et al. (2016)	N=26 (15 PRP, 11 Placebo)	Adult females (≥18)	Androgenetic Alopecia (AGA)	Ludwig II
El-Dawla et al. (2023)	N=30 (10 Special PRP, 10 Ordinary PRP, 10 Placebo)	Group 1: Median 31.5; Group 2: Median 29; Group 3: Median 27	Chronic Telogen Effluvium (CTE)	Visual Analog Scale (Hair Shedding)
Lee et al. (2015)	N=40 (20 PRP+PDRN, 20 PDRN)	Total: Mean 33.9 (Range 20–60); PRP group: Mean 35.4	Female Pattern Hair Loss (FPHL)	Not specified (clinical exam/phototrichogram outcomes)

Meta-analysis

In the meta-analysis, PRP was associated with a higher hair density compared with control (pooled SMD = 3.39, 95% CI 2.27–4.52; Figure 2). PRP also increased hair thickness versus control (pooled SMD = 2.78, 95% CI 1.91–3.65; Figure 3). For hair count, the pooled effect did not show a clear difference between PRP and control (pooled SMD = −0.95, 95% CI −17.87 to 15.96; Figure 4). PRP reduced the number of pulled hairs compared with control (pooled SMD = −3.75, 95% CI −5.59 to −1.92; Figure 5).

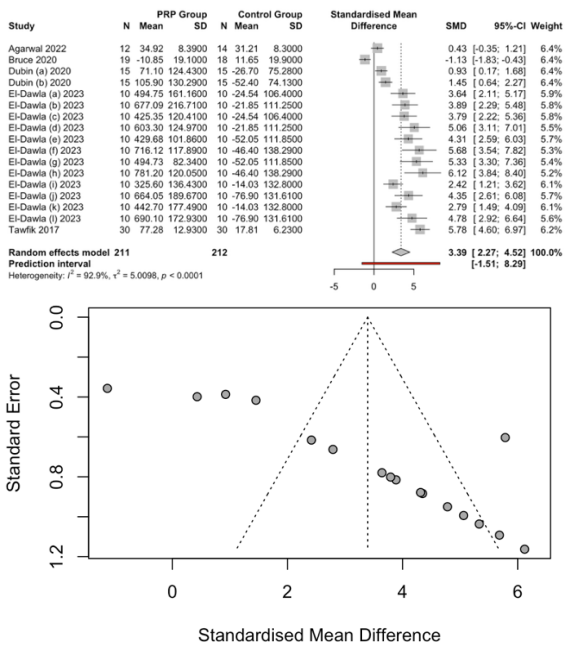

Figure 2. Pooled effect estimate for hair density between patients receiving PRP vs control group.

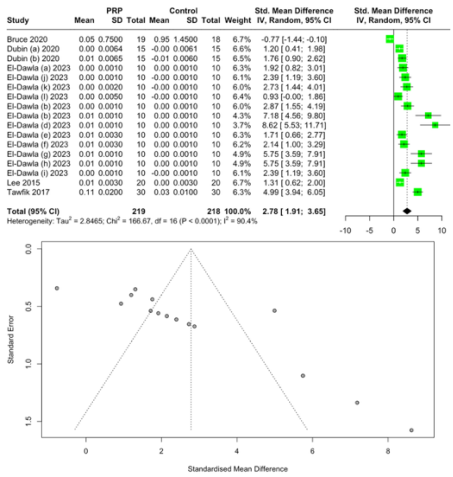

Figure 3. Pooled effect estimate for hair thickness between patients receiving PRP vs control group.

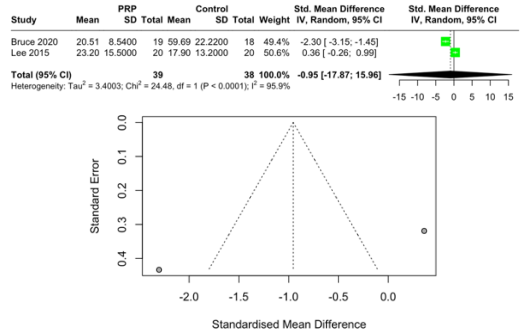

Figure 4. Pooled effect estimate for hair count between patients receiving PRP vs control group.

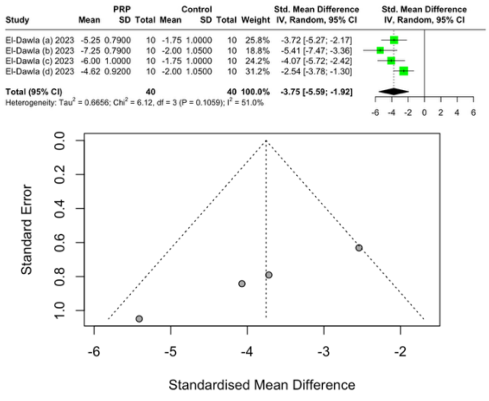

Figure 5. Pooled effect estimate for pulled hair number between patients receiving PRP vs control group.

Risk of Bias Analysis

Overall risk of bias was low for Bruce et al. (2020), Agarwal & Mendiratta (2023), and El-Dawla et al. (2023), while Dubin et al. (2020), Tawfik & Osman (2018), and Puig et al. (2016) were judged moderate overall. Lee et al. (2015) showed the greatest concern with an overall serious risk of bias, including serious issues in participant selection and missing data domains. Across studies, most domains were rated low risk, with higher-risk ratings occurring mainly in confounding/selection, missing data, and outcome measurement for a subset of trials (Figure 6).

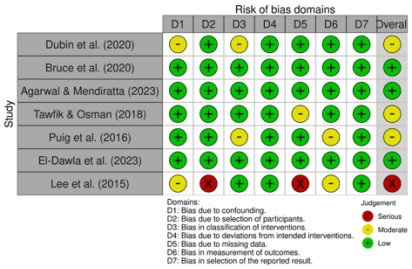

Figure 6. ROBINS-I risk of bias tool.

Discussion

The present systematic review and meta-analysis suggest that PRP is associated with improvements in several clinically relevant hair parameters, most consistently hair density and hair shaft thickness, while effects on absolute hair count were not clearly demonstrable. Clinically, this pattern is plausible: density and thickness are sensitive to shifts in follicular cycling and miniaturization, whereas "hair count" outcomes can be strongly affected by measurement technique, imaging field consistency, and baseline heterogeneity.[18] PRP delivers a concentrated milieu of platelet-derived bioactive mediators (e.g., growth factors and cytokines) that may influence dermal papilla activity, perifollicular vascular supply, and extracellular matrix remodeling.[19] The observed reduction in pulled-hair numbers also aligns with a potential shift toward anagen stabilization and reduced telogen shedding, consistent with the follicle's cycling biology and the role of the perifollicular microenvironment in anchoring and retention.[19]

However, the broader evidence base remains heterogeneous, and several consistent clinical signals temper interpretation. Improvements within both intervention and control arms suggest that needling/microtrauma, local inflammatory signaling, and regression to the mean can materially influence outcomes.[20] This is

important anatomically: the scalp is highly vascularized, and intradermal/subdermal injection or needling may stimulate wound-healing pathways (including angiogenic and fibroblast responses) that transiently improve hair appearance and density independent of PRP content.[21] At the same time, between-study variability in PRP preparation (platelet concentration, leukocyte content, activation status, injected volume and depth) supports the view that PRP is not a single standardized intervention.[21] Differences in platelet dose and activation are biologically meaningful because platelet degranulation and growth-factor release kinetics can vary, potentially altering downstream signaling in the follicular niche.[22] These mechanistic considerations help explain why some trials demonstrate clear superiority over placebo or comparators at mid-term follow-up while others show minimal or no objective advantage, positioning PRP as a moderately effective therapy whose benefit likely depends on protocol standardization and patient selection (e.g., earlier disease stage, preserved follicular units, and lower baseline miniaturization).[23]

Across additional alopecia phenotypes, the clinical role of PRP appears condition-specific. In alopecia areata, where immune-mediated attack targets the follicle, PRP potential immunomodulatory effects may support symptom improvement or partial regrowth, but existing comparisons often favor intralesional corticosteroids for robust regrowth, suggesting PRP is best positioned as an adjunct or alternative when steroids are contraindicated or poorly tolerated.[24] For chronic telogen effluvium, early controlled data indicating improvements in trichoscopic parameters and patient-reported shedding are biologically plausible because telogen effluvium reflects dysregulation of cycling dynamics and trigger-related shifts into telogen;[25] PRP may promote a more favorable anagen–telogen balance through trophic support of the follicular unit. In scarring alopecias, where follicular destruction and perifollicular fibrosis dominate, current evidence is insufficient to recommend PRP as a replacement for immunomodulatory standards of care;[26] once follicular stem cell niches are lost and fibrosis is established, regenerative signals alone are unlikely to restore terminal follicles.[26] Taken together, these findings support PRP as a generally well-tolerated intervention with potential benefit in non-scarring alopecias, while underscoring the need for larger, well-controlled trials with standardized PRP characterization, consistent outcome measurement, and clinically meaningful comparators to define where PRP adds durable value in real-world practice.

Study limitations

This review has several important constraints that should be considered when interpreting the findings. First, the number of eligible studies and total pooled sample sizes were modest, and several trials used split-scalp or small parallel-group designs that are vulnerable to contamination, placebo effects, and regression to the mean.[27] Second, there was substantial clinical and methodological heterogeneity across studies, including variability in PRP preparation (platelet concentration, leukocyte content, activation method), injection technique (depth, spacing, volume), treatment schedules, and follow-up duration, which limits the ability to attribute effects to a reproducible “dose” of PRP and likely contributes to inconsistent outcomes. Third, outcome reporting lacked uniformity reducing comparability and increasing the risk of selective outcome reporting. Finally, risk of bias was not uniformly low across studies, and incomplete adverse-event reporting limits confidence in estimating uncommon harms, particularly for longer-term safety and durability.

Conclusion

In summary, PRP appears to offer a clinically meaningful improvement in hair density and hair shaft thickness in selected patients, with a generally favorable tolerability profile, but effects on absolute hair count are less certain and overall efficacy is sensitive to protocol and patient factors. The biological rationale is

consistent with PRP's capacity to influence the follicular microenvironment, angiogenesis, and cycling dynamics, supporting its role as a non-surgical regenerative option in non-scarring alopecias. Nevertheless, PRP should currently be viewed as an adjunctive or selectively applied treatment rather than a universal replacement for established first-line therapies, especially given heterogeneity in preparation and delivery. Future multicentre randomized trials using standardized PRP characterization, clinically relevant comparators, longer follow-up, and harmonized patient-centred outcomes are needed to define optimal protocols and clarify which subgroups derive the most durable benefit.

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None.

References

1. Mendoza, L. A., Ocampo, G. G., Abarca-Pineda, Y. A., Ahmad Khan, M., Ahmadi, Y., Brown, N., Deowan, D., & Nazir, Z. (2025). Comprehensive Review on Hair Loss and Restorative Techniques: Advances in Diagnostic, Artistry, and Surgical Innovation. *Cureus*, *17*(4), e82991. https://doi.org/10.7759/cureus.82991

2. 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

3. Villasante Fricke, A. C., & Miteva, M. (2015). Epidemiology and burden of alopecia areata: A systematic review. *Clinical, Cosmetic and Investigational Dermatology*, *8*, 397–403. https://doi.org/10.2147/CCID.S53985

4. Penha, M. A., Miot, H. A., Kasprzak, M., & Müller Ramos, P. (2024). Oral Minoxidil vs Topical Minoxidil for Male Androgenetic Alopecia: A Randomized Clinical Trial. *JAMA Dermatology*, *160*(6), 600–605. https://doi.org/10.1001/jamadermatol.2024.0284

5. Wu, W.-S., Chen, L.-R., & Chen, K.-H. (2025). Platelet-Rich Plasma (PRP): Molecular Mechanisms, Actions and Clinical Applications in Human Body. *International Journal of Molecular Sciences*, *26*(21), 10804. https://doi.org/10.3390/ijms262110804

6. Kataria, S., Patel, U., Yabut, K., Patel, J., Patel, R., Patel, S., Wijaya, J. H., Maniyar, P., Karki, Y., Makrani, M. P., Viswanath, O., & Kaye, A. D. (2024). Recent Advances in Management of Neuropathic, Nociceptive, and Chronic Pain: A Narrative Review with Focus on Nanomedicine, Gene Therapy, Stem Cell Therapy, and Newer Therapeutic Options. *Current Pain and Headache Reports*, *28*(5), 321–333. https://doi.org/10.1007/s11916-024-01227-5

7. Rhadika, A., Romano, S. A., Widyatmiko, H., Tanuwijaya, A. W., Putra, P. S. P. H., Amanah, S. R., Elashry, A. R., Javaid, S., Inggas, M. A. M., & Wijaya, J. H. (2025). Efficacy and Safety of Stem Cell Therapy for Spinal Cord Injury in Adults: A Systematic Review and Meta-Analysis. *Medicinus*, *15*(1), 66–80. https://doi.org/10.19166/med.v15i1.10762

8. *Evidence review for chronic pain: Cannabis-based medicinal products: Evidence review B*. (2019). National Institute for Health and Care Excellence (NICE). http://www.ncbi.nlm.nih.gov/books/NBK577083/

9. 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

10. Agarwal, A., & Mendiratta, V. (2023). Comparative Efficacy of Topical Minoxidil Alone Against Combination of Topical Minoxidil and Platelet Rich Plasma in Women with Female Pattern Hair Loss-A Pilot, Open Randomised Trial. *Indian Journal of Dermatology*, *68*(1), 121. https://doi.org/10.4103/ijd.ijd_461_22

11. Bruce, A. J., Pincelli, T. P., Heckman, M. G., Desmond, C. M., Arthurs, J. R., Diehl, N. N., Douglass, E. J., Bruce, C. J., & Shapiro, S. A. (2020). A Randomized, Controlled Pilot Trial Comparing Platelet-Rich Plasma to Topical Minoxidil Foam for Treatment of Androgenic

Alopecia in Women. *Dermatologic Surgery: Official Publication for American Society for Dermatologic Surgery [et Al.]*, *46*(6), 826–832. https://doi.org/10.1097/DSS.0000000000002168

12. Dubin, D. P., Lin, M. J., Leight, H. M., Farberg, A. S., Torbeck, R. L., Burton, W. B., & Khorasani, H. (2020). The effect of platelet-rich plasma on female androgenetic alopecia: A randomized controlled trial. *Journal of the American Academy of Dermatology*, *83*(5), 1294–1297. https://doi.org/10.1016/j.jaad.2020.06.1021

13. El-Dawla, R. E., Abdelhaleem, M., & Abdelhamed, A. (2023). Evaluation of the safety and efficacy of platelet-rich plasma in the treatment of female patients with chronic telogen effluvium: A randomised, controlled, double-blind, pilot clinical trial. *Indian Journal of Dermatology, Venereology and Leprology*, *89*(2), 195–203. https://doi.org/10.25259/IJDVL_1011_20

14. Lee, S.-H., Zheng, Z., Kang, J.-S., Kim, D.-Y., Oh, S. H., & Cho, S. B. (2015). Therapeutic efficacy of autologous platelet-rich plasma and polydeoxyribonucleotide on female pattern hair loss. *Wound Repair and Regeneration: Official Publication of the Wound Healing Society [and] the European Tissue Repair Society*, *23*(1), 30–36. https://doi.org/10.1111/wrr.12250

15. Puig, C. J., Reese, R., & Peters, M. (2016). Double-Blind, Placebo-Controlled Pilot Study on the Use of Platelet-Rich Plasma in Women With Female Androgenetic Alopecia. *Dermatologic Surgery: Official Publication for American Society for Dermatologic Surgery [et Al.]*, *42*(11), 1243–1247. https://doi.org/10.1097/DSS.0000000000000883

16. Tawfik, A. A., & Osman, M. A. R. (2018). The effect of autologous activated platelet-rich plasma injection on female pattern hair loss: A randomized placebo-controlled study. *Journal of Cosmetic Dermatology*, *17*(1), 47–53. https://doi.org/10.1111/jocd.12357

17. Yuan, J., He, Y., Wan, H., & Gao, Y. (2024). Effectiveness of platelet-rich plasma in treating female hair loss: A systematic review and meta-analysis of randomized controlled trials. *Skin Research and Technology: Official Journal of International Society for Bioengineering and the Skin (ISBS) [and] International Society for Digital Imaging of Skin (ISDIS) [and] International Society for Skin Imaging*, *30*(8), e70004. https://doi.org/10.1111/srt.70004

18. Kinoshita-Ise, M., Fukuyama, M., & Ohyama, M. (2023). Recent Advances in Understanding of the Etiopathogenesis, Diagnosis, and Management of Hair Loss Diseases. *Journal of Clinical Medicine*, *12*(9), 3259. https://doi.org/10.3390/jcm12093259

19. Vrapcea, A., Pisoschi, C. G., Ciupeanu-Calugaru, E. D., Traşcă, E.-T., Tutunaru, C. V., Rădulescu, P.-M., & Rădulescu, D. (2025). Inflammatory Signatures and Biological Markers in Platelet-Rich Plasma Therapy for Hair Regrowth: A Comprehensive Narrative Analysis. *Diagnostics*, *15*(9), 1123. https://doi.org/10.3390/diagnostics15091123

20. Stretanski, M. F., Hu, Y., & Mesfin, F. B. (2025). Disk Herniation. In *StatPearls*. StatPearls Publishing. http://www.ncbi.nlm.nih.gov/books/NBK441822/

21. Pan, X., Yu, R., Wu, J., Li, W., Huang, R., Huang, W., Huang, Y., Wang, Y., & Zuo, H. (2025). Technological Advances in Anti-hair Loss and Hair Regrowth Cosmeceuticals: Mechanistic Breakthroughs and Industrial Prospects Driven by Multidisciplinary Collaborative Innovation. *Aesthetic Plastic Surgery*, *49*(19), 5341–5390. https://doi.org/10.1007/s00266-025-05077-3

22. Scridon, A. (2022). Platelets and Their Role in Hemostasis and Thrombosis—From Physiology to Pathophysiology and Therapeutic Implications. *International Journal of Molecular Sciences*, *23*(21), 12772. https://doi.org/10.3390/ijms232112772

23. Glinkowski, W. M., Gut, G., & Śladowski, D. (2025). Platelet-Rich Plasma for Knee Osteoarthritis: A Comprehensive Narrative Review of the Mechanisms, Preparation Protocols, and Clinical Evidence. *Journal of Clinical Medicine*, *14*(11), 3983. https://doi.org/10.3390/jcm14113983

24. Arabzadeh Bahri, R., Maleki, S., Shafiee, A., Ghandi, N., Abedini, R., Ehsani, A. H., Ehsani, A., & Razavi, Z. (2023). Efficacy and Safety of Platelet-Rich Plasma Therapy in Alopecia Areata Patients: A Systematic Review. *Dermatologic Therapy*, *2023*(1), 8827644. https://doi.org/10.1155/2023/8827644

25. Chadha, A., Burmeister, M., & Poelker-Wells, S. (2026). Modeling Oxidative Stress-Linked Telogen Effluvium Using Monte Carlo Simulation of Published Trichoscopy Norms and Cannabis Exposure Distributions. *Cureus*. https://doi.org/10.7759/cureus.101446

26. Roh, E. (2025). Advancements in Bioactive Compounds and Therapeutic Agents for Alopecia: Trends and Future Perspectives. *Cosmetics*, *12*(6), 287. https://doi.org/10.3390/cosmetics12060287

27. Giguère, A., Zomahoun, H. T. V., Carmichael, P.-H., Uwizeye, C. B., Légaré, F., Grimshaw, J. M., Gagnon, M.-P., Auguste, D. U., & Massougbodji, J. (2020). Printed educational materials: Effects on professional practice and healthcare outcomes. *The Cochrane Database of Systematic Reviews*, *8*(8), CD004398. https://doi.org/10.1002/14651858.CD004398.pub4

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(Claudia Felicia Limanda)