



PLATELET-RICH PLASMA (PRP) IN HAIR TRANSPLANTATION: A COMPREHENSIVE REVIEW

1Dr. PRADEEP CHRISTOPHER, 2AKSHAYA THARININ. P, 3ALLWYN SUSIL. A, 4Dr. GAYATHRI, 5Dr. MOHAMED
AFRADH

1PROFESSOR & HOD, 2STUDENT, 3STUDENT, 4READER, 5READER

1DR MGR EDUCATIONAL AND RESEARCH INSTITUTE.,

2DR MGR EDUCATIONAL AND RESEARCH INSTITUTE.,

3DR MGR EDUCATIONAL AND RESEARCH INSTITUTE.,

4DR MGR EDUCATIONAL AND RESEARCH INSTITUTE.,

5DR MGR EDUCATIONAL AND RESEARCH INSTITUTE.

ABSTRACT

Hair transplantation is a widely accepted surgical procedure for treating androgenic alopecia (male and female pattern baldness). In recent years, Platelet-Rich Plasma (PRP) has gained significant attention as an adjunctive therapy to enhance hair transplant outcomes. PRP is an autologous concentrate derived from the patient's blood, rich in growth factors and cytokines, which can stimulate hair follicle growth and improve the overall success of hair transplantation. This review article aims to provide a comprehensive overview of the current state of knowledge on the application of PRP in hair transplantation. It covers the scientific basis of PRP, PRP preparation methods, administration techniques, and the existing evidence supporting its efficacy and safety in hair restoration procedures.

Keywords: Platelet-rich plasma, PRP, hair transplantation, regenerative medicine, hair loss, growth factors, clinical applications, efficacy, safety, adverse events, future directions.

INTRODUCTION

Platelet-rich plasma (PRP) was initially introduced in Hematology as a concentrated plasma with elevated platelet levels, primarily used for treating thrombocytopenia through transfusion since 1970. Over time, PRP has evolved into a versatile treatment option for various medical fields, including sports medicine, regenerative medicine, aesthetic medicine, and hair loss treatment.¹ This shift in application is due to PRP's rich content of growth factors and cytokines, which facilitate wound healing and tissue restoration. In contemporary medical practice, PRP has gained popularity as a therapeutic approach in hair loss treatment, offering hope to individuals seeking to combat alopecia and restore their hairline and density.² By utilizing the concentrated platelets and their regenerative components, PRP aims to support hair follicles, accelerate healing, and enhance overall hair regrowth outcomes. Despite the widespread application of PRP in different medical domains, the precise mechanism underlying its efficacy in promoting hair regrowth remains an area of ongoing research.³ As such, this review aims to explore the effectiveness of PRP as a hair loss treatment comprehensively. It will encompass a detailed examination of PRP's definition, classification, mode of action, clinical efficacy in promoting hair regrowth, and potential adverse effects. Given the significant potential of PRP in hair restoration, it is essential to assess its effectiveness and safety thoroughly. The use of PRP for hair loss treatment falls under the regulatory purview of the US Food and Drug Administration (FDA), with approved applications for blood transfusion. However, the utilization of PRP for other medical purposes, including hair loss treatment, is considered "off label use," which remains permissible if administered by a licensed physician for the purpose of medical practice.⁴ By conducting an in-depth review of PRP in the context of hair loss treatment, this study aims to contribute valuable insights to both clinicians and patients seeking evidence-based solutions for hair restoration. Understanding the current state of knowledge surrounding PRP and its potential limitations will help guide medical practitioners in providing effective treatment options for individuals experiencing hair loss.

SCIENTIFIC BASIS AND CLASSIFICATION

Platelet-Rich Plasma (PRP) has been extensively studied and found to possess a wide array of biological effects beyond its role in the hemostatic system. Through the release of various growth factors and cytokines from its alpha granules, PRP influences several processes crucial for tissue repair and regeneration. Some of the essential growth factors found in PRP include Platelet-Derived Growth Factor (PDGF), Transforming Growth Factor β (TGF- β), Fibroblast Growth Factor-2 (FGF-2), Vascular Endothelial Growth Factor (VEGF), Epidermal Growth Factor (EGF), Insulin-like Growth Factor-1 (IGF-1), and Glial Cell Line-Derived Neurotrophic Factor (GDNF).⁵ These growth factors play vital roles in stimulating hair growth by promoting cell proliferation, differentiation, angiogenesis (formation of new blood vessels), and extending the anagen phase of the hair growth cycle. Additionally, PRP induces the proliferation of dermal papilla (DP) cells through specific signaling pathways, contributing to increased hair follicle survival and growth. Studies have demonstrated that PRP treatment leads to enhanced follicular bulge cells, increased hair follicle density, epidermal thickening, and improved vascularization in the scalp tissue. To classify and standardize PRP preparations, researchers have proposed various classification systems. Mishra's PRP classification system categorizes PRP based on the presence or absence of white blood cells, activation status, and platelet concentration coefficient compared to whole-blood baseline.^{5,6} Dohan Ehrenfest et al. proposed a classification system based on individual components (platelet and leukocyte concentrations) and the presence or absence of fibrin, categorizing PRP

into pure PRP (P-PRP), leukocyte and PRP (L-PRP), pure platelet-rich fibrin (P-PRF), and leukocyte and platelet-rich fibrin (L-PRF).⁷ In 2016, Magalon et al. introduced the DEPA classification, which standardizes PRP based on four components: the dose of injected platelets, efficiency of production, purity of the PRP obtained, and activation process.⁸ This classification system considers the platelet concentration, volume of PRP preparation, and dose of injected platelets to better assess the efficacy and quality of PRP formulations.

METHODS OF PREPARATION

Platelet-Rich Plasma (PRP) preparation methods vary, leading to different compositions and potential efficacy. Common methods include single-spin and double-spin techniques, using commercial kits or manual centrifugation. PRP is obtained from whole blood collected with an anticoagulant to prevent clotting. It is then centrifuged to separate red blood cells, followed by a second centrifugation step to concentrate platelets. Currently, there is a lack of standardized methods for the preparation and application of Platelet-Rich Plasma (PRP) in the context of hair loss treatment. Various protocols have been reported in the literature, including both commercial kits and manual methods using a laboratory centrifuge. Different devices and techniques may lead to PRP preparations with varying platelet concentrations and leukocyte counts. The general procedure for PRP preparation involves collecting blood with an anticoagulant to prevent clotting and platelet activation. Subsequently, the whole blood is centrifuged to separate the red blood cells, and then another centrifugation step concentrates the platelets. Some protocols include the addition of exogenous platelet activators before administration to induce the immediate release of growth factors.⁹ However, there is no consensus on whether this activation step improves efficacy. It's also noted that non-activated or resting PRP can be injected, and spontaneous platelet activation occurs upon exposure to dermal collagen and thrombin. The optimal number of PRP treatments and the time intervals between them has not been established, and the wide variation in PRP preparation protocols may result in samples with different compositions of platelets, leukocytes, erythrocytes, and growth factors. This variability in composition could potentially induce different biological responses. The platelet concentration factor is one of the most frequently discussed parameters influencing PRP efficacy. Studies suggest that a concentration of platelets two to six times higher than the basal platelet count is needed for optimal outcomes in tissue regeneration. The presence of leukocytes in PRP remains a topic of debate. While some believe that leukocytes enhance growth factor release, contribute to angiogenesis, and offer protection against infection, others express concerns about their potential to increase inflammation and matrix degradation. Moreover, the presence of erythrocytes, although usually removed in most PRP preparation methods, may act as a source of reactive oxygen species and induce inflammatory stress.¹⁰

PRP ADMINISTRATION TECHNIQUES IN HAIR TRANSPLANTATION

Platelet-Rich Plasma (PRP) can be administered in hair transplantation through various techniques, depending on the specific treatment goals and the preferences of the clinician. Some common PRP administration techniques in hair transplantation include:

Subcutaneous Injections: In this technique, PRP is injected into the subcutaneous layer of the scalp in areas affected by hair loss. The injections are strategically placed to target the hair follicles and the surrounding tissues. Subcutaneous injections allow for the direct delivery of growth factors and cytokines to the hair follicles, promoting hair growth and enhancing the overall health of the scalp.

Micro-needling with PRP: Micro-needling is a procedure that involves creating small micro-injuries in the scalp using a specialized device with tiny needles. When combined with PRP, this technique is believed to enhance the absorption and effectiveness of PRP by creating microchannels for improved penetration of growth factors into the deeper layers of the skin. Micro-needling with PRP can stimulate hair follicle regeneration and promote hair growth.

Topical Application: PRP can also be applied topically to the scalp after a hair transplantation procedure or as a standalone treatment. The PRP is gently massaged into the scalp, allowing the growth factors to be absorbed and distributed across the treated area. Topical PRP application is a non-invasive method that can complement other hair restoration treatments.

Combination with Hair Transplantation Surgery: PRP is often used in combination with hair transplantation surgery to enhance the success of the procedure. Before or during the transplant surgery, PRP may be injected into the recipient area to support graft survival and encourage faster healing. Additionally, PRP can be applied to the donor area to aid in wound healing and minimize scarring.

Post-Transplant Maintenance: PRP can be used as a post-transplant maintenance treatment to improve the growth and health of transplanted hair follicles. Regular PRP sessions may be recommended to sustain hair growth and optimize the results of the hair transplantation.¹¹

CLINICAL EVIDENCE OF PRP EFFICACY IN HAIR TRANSPLANTATION

Several pilot studies and clinical trials have investigated the efficacy of Platelet-Rich Plasma (PRP) in hair transplantation for androgenetic alopecia (AGA). Anitua et al. conducted a pilot study with 19 subjects with AGA who received 5 injections of PRP enhanced with platelet-rich growth factor (PRGF) activator. After one year of follow-up, there were significant improvements in hair density, hair diameter, and terminal/vellus hair ratio.¹² Alves and Grimalt led a randomized, blinded, half-head study with 25 subjects. PRP-treated areas showed significant improvements in anagen hairs, telogen hairs, hair density, and terminal hair density compared to placebo-treated areas after 3 and 6 months.¹³ Gentile et al. performed a randomized, blinded, half-head study with 20 male subjects. PRP treatment led to a statistically significant increase in hair count, hair density, and terminal hair density after 3 months compared to the placebo-treated side.¹⁴ Gupta et al. conducted an open-labeled pilot study with 30 male participants who received PRP massage treatments after microneedling. After 6 months, there was a significant increase in hair diameter and density, with an average improvement of 30.2% based on global photographs.¹⁵ Singhal et al. conducted a small clinical trial comparing PRP with medical treatment in 20 subjects. Although not statistically analyzed, PRP-treated subjects showed superior outcomes in hair pull test and hair growth compared to the control group. Preliminary and observational studies by Schiavone et al., Gkini et al., and Khatu et al. all reported positive therapeutic effects of PRP in subjects with AGA. Improved hair density, thickness, and patient satisfaction were observed in these studies. In one of the earliest controlled clinical trials^{16,17}, Takikawa et al. treated 26 subjects with PRP containing dalteparin and protamine microparticles (D/P MPs). PRP-treated areas showed increased hair count and hair cross section compared to control areas.¹⁸

SAFETY AND SIDE EFFECTS OF PRP IN HAIR TRANSPLANTATION

Platelet-Rich Plasma (PRP) has generally been considered a safe and well-tolerated treatment in hair transplantation. Since PRP is derived from the patient's own blood, the risk of allergic reactions or transmission of infections is minimal. Some patients may experience mild pain or discomfort at the injection sites during or after PRP treatment. However, this is usually temporary and can be managed with over-the-counter pain medications if needed. Swelling and bruising at the injection sites may occur, especially if the treatment involves multiple injections. These side effects are usually mild and resolve on their own within a few days. While the risk of infection is low due to the autologous nature of PRP (using the patient's own blood), there is still a slight possibility of infection at the injection sites. It's essential for the procedure to be performed in a sterile environment by a qualified medical professional to minimize this risk. Allergic reactions to PRP are extremely rare since the treatment uses the patient's own blood components. However, in rare cases, some individuals may still develop an allergic response. It's essential to inform the healthcare provider about any known allergies before undergoing the procedure. PRP may not produce significant results in all patients, and individual responses to treatment can vary. Some individuals may experience more noticeable hair growth and density improvements, while others may see limited or no effect. The cost of PRP treatment for hair transplantation can be a consideration for some patients, as it may require multiple sessions to achieve the desired results. It's essential for patients to discuss the potential benefits and cost implications with their healthcare provider. Patients with extremely low platelet counts are not suitable candidates for PRP treatment as they may not have enough platelets to create an effective PRP preparation.^{19,20}

FACTORS AFFECTING PRP RESPONSE

The response to Platelet-Rich Plasma (PRP) treatment in hair transplantation can vary among individuals due to several factors. Younger patients tend to have better responses to PRP treatment as their hair follicles are generally more active and responsive to growth factors. The extent of hair loss plays a role in the response to PRP. Early-stage hair loss (less advanced alopecia) tends to respond better compared to advanced stages of hair loss. PRP is more likely to be effective in cases of androgenetic alopecia (AGA) or hereditary hair loss. Hair loss due to other medical conditions may not respond as well to PRP treatment. A patient's overall health, diet, exercise, and lifestyle choices can influence the response to PRP treatment. A healthy lifestyle can promote better results. Hormonal imbalances, such as those seen in certain medical conditions or during pregnancy, can affect hair growth and may influence the response to PRP. Individual immune responses to the PRP treatment can vary, leading to differences in the rate and extent of hair growth.³ The method of PRP preparation can influence the concentration of growth factors and cytokines, affecting its effectiveness in promoting hair growth.

The frequency and number of PRP sessions can impact the treatment's success. Multiple sessions may be required for optimal results. Combining PRP with other hair restoration therapies or medications can affect the overall response to treatment. Genetic variations can play a role in how individuals respond to PRP treatment. Some people may be genetically predisposed to better or poorer responses. Following the post-treatment care and guidelines provided by the healthcare provider is essential for maximizing the benefits of PRP therapy.

CONCLUSION

Future directions for Platelet-Rich Plasma (PRP) in hair transplantation involve standardizing preparation methods, optimizing formulations, and exploring combination therapies. Long-term efficacy studies, mechanistic investigations, and large-scale clinical trials are needed to establish its true potential. Challenges include variable patient responses, patient selection criteria, cost, accessibility, and regulatory oversight. Despite these challenges, PRP shows promise in hair restoration, and with further research and refinement, it holds potential as a safe and effective treatment for hair loss. In conclusion, PRP has emerged as a popular and promising option in hair transplantation, showing positive clinical evidence in promoting hair growth. While further research is needed to address the challenges and optimize its use, PRP represents an exciting avenue for improving hair restoration therapies.

REFERENCES

1. Marx RE, Carlson ER, Eichstaedt RM, et al. Platelet rich plasma: growth factor enhancement for bone grafts. *Oral Surg Oral Med Oral Pathol Oral Radiol Endod.* 1998;85:638–646. doi: 10.1016/s1079-2104(98)90029-4
2. Kang J-S, Zheng Z, Choi MJ, et al. The effect of CD341 cell-containing autologous platelet-rich plasma injection on pattern hair loss: a preliminary study. *J Eur Acad Dermatol Venereol.* 2014;28(1):72–79
3. Paichitrojjana A, Paichitrojjana A. Platelet Rich Plasma and Its Use in Hair Regrowth: A Review. *Drug Des Devel Ther.* 2022 Mar 10;16:635-645. doi: 10.2147/DDDT.S356858. PMID: 35300222; PMCID: PMC8922312.
4. usticz N, Derakhshan A, Chen JX, et al. Platelet-rich plasma for hair restoration. *Facial Plas Surg Clin North Am.* 2020;28(2):181–187. doi: 10.1016/j.fsc.2020.01.009
5. Mishra A., Harmon K., Woodall J., Vieira A. Sports medicine applications of platelet rich plasma. *Curr Pharm Biotechnol.* 2012;13(7):1185–1195.
6. Stevens J, Khetarpal S. Platelet-rich plasma for androgenetic alopecia: A review of the literature and proposed treatment protocol. *Int J Womens Dermatol.* 2018 Sep 21;5(1):46-51. doi: 10.1016/j.ijwd.2018.08.004. PMID: 30809579; PMCID: PMC6374694.
7. Dohan Ehrenfest D.M., Rasmusson L., Albrektsson T. Classification of platelet concentrates: from pure platelet-rich plasma (P-PRP) to leucocyte- and platelet-rich fibrin (L-PRF) *Trends Biotechnol.* 2009;27(3):158–167.
8. Magalon J, Chateau AL, Bertrand B, et al. DEPA classification: a proposal for standardising PRP use and a retrospective application of available devices. *BMJ Open Sport Exerc Med.* 2016;2(1):e000060. doi: 10.1136/bmjsem-2015-000060
9. Alves R, Grimalt R. A review of platelet-rich plasma: history, biology, mechanism of action, and classification. *Skin Appendage Disord.* 2018;4(1):18–24. doi: 10.1159/000477353
10. Stevens J, Khetarpal S. Platelet-rich plasma for androgenetic alopecia: a review of the literature and proposed treatment protocol. *Int J Womens Dermatol.* 2018;5(1):46–51. doi: 10.1016/j.ijwd.2018.08.004
11. Garg S. Outcome of Intra-operative Injected Platelet-rich Plasma Therapy During Follicular Unit Extraction Hair Transplant: A Prospective Randomised Study in Forty Patients. *J Cutan Aesthet Surg.* 2016 Jul-Sep;9(3):157-164. doi: 10.4103/0974-2077.191657. PMID: 27761085; PMCID: PMC5064679.

12. Anitua E, Pino A, Martinez N, Orive G, Berridi D: The effect of plasma rich in growth factors on pattern hair loss: a pilot study. *Dermatol Surg* 2017;43:658-670
13. Alves R, Grimalt R: Randomized placebo-controlled, double-blind, half-head study to assess the efficacy of platelet-rich plasma on the treatment of androgenetic alopecia. *Dermatol Surg* 2016;42:491-497.
14. Gentile P, Garcovich S, Bielli A, Scioli MG, Orlandi A, Cervelli V: The effect of platelet-rich plasma in hair regrowth: a randomized placebo-controlled trial. *Stem Cells Transl Med* 2015;4:1317-1323.
15. Singhal P, Agarwal S, Dhot PS, Sayal SK: Efficacy of platelet-rich plasma in treatment of androgenic alopecia. *Asian J Transfus Sci* 2015;9:159-162.
16. Gupta S, Revathi TN, Sacchidanand S, Nataraj HV: A study of the efficacy of platelet-rich plasma in the treatment of androgenetic alopecia in males. *Indian J Dermatol Venereol Leprol* 2017;83:412.
17. Gkini M-A, Kouskoukis A-E, Tripsianis G, Rigopoulos D, Kouskoukis K: Study of platelet-rich plasma injections in the treatment of androgenetic alopecia through a one-year period. *J Cutan Aesthet Surg* 2014;7:213-219.
18. Takikawa M, Nakamura S, Nakamura S, Ishirara M, Kishimoto S, Sasaki K, Yanagibayashi S, Azuma R, Yamamoto N, Kiyosawa T: Enhanced effect of platelet-rich plasma containing a new carrier on hair growth. *Dermatol Surg* 2011;37:1721-1729.
19. Almohanna HM, Ahmed AA, Griggs JW, et al. Platelet-rich plasma in the treatment of alopecia areata: a review. *J Investig Dermatol Symp Proc.* 2020;**20**(1):S45–S49. doi: 10.1016/j.jisp.2020.05.002
20. Gentile P, Garcovich S. Systematic review of platelet-rich plasma use in androgenetic alopecia compared with Minoxidil®, Finasteride®, and adult stem cell-based therapy. *Int J Mol Sci.* 2020;**21**(8):2702. doi: 10.3390/ijms21082702

