Quest Journals
Journal of Medical and Dental Science Research
Volume 12~ Issue 5 (May 2025) pp: 36-40
ISSN(Online): 2394-076X ISSN (Print):2394-0751
www.questjournals.org

Research Paper

The Role of injectable platelet-rich fibrin(i-PRF) and Advanced platelet-rich fibrin(A-PRF) in Androgenetic Alopecia: A New Frontier in Hair Regeneration

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Abstract
Androgenetic alopecia (AGA) is a prevalent condition that causes progressive hair thinning and loss, affecting both men and women. Despite existing treatments, their efficacy is inconsistent, leading to the exploration of alternative therapies. Recent advances in regenerative medicine, especially platelet-rich fibrin (PRF), show promise for stimulating hair regrowth. Specifically, injectable platelet-rich fibrin (i-PRF) and advanced platelet-rich fibrin (A-PRF) have been highlighted for their potential in AGA management. This article explores their roles, mechanisms, clinical efficacy, and potential benefits over traditional treatments.

Keywords: *Androgenetic Alopecia, Injectable platelet-rich fibrin (i-PRF), Advanced platelet-rich fibrin (A-PRF), Growth factor, Hair regeneration.*

***R**eceived 16 May., 2025; **R**evised 28 May., 2025; **A**ccepted 31 May., 2025 © The author(s) 2025.*
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I. INTRODUCTION

Hair plays a significant role in physical appearance and self-esteem, and its loss can profoundly affect confidence. Androgenetic alopecia (AGA) is a hereditary condition that results in the progressive thinning of scalp hair. The condition is linked to the shortening of the anagen phase of the hair cycle, follicular miniaturization, and the depletion of active hair follicles. While treatments like minoxidil, finasteride, and hair transplantation exist, they often provide temporary or suboptimal results for many patients, prompting interest in new alternatives, such as platelet-rich fibrin (PRF) derivatives like i-PRF and A-PRF.

PRF, is an autologous platelet concentrate derived from the patient's own blood, offers a regenerative solution by releasing growth factors in a controlled, sustained manner. This article delves into i-PRF and A-PRF as promising therapies in AGA, investigating their mechanisms, effectiveness, and advantages.

PRF: The Basis for i-PRF and A-PRF

Platelet-rich fibrin (PRF) is derived through a process of blood collection, centrifugation, and fibrin matrix formation. Unlike platelet-rich plasma (PRP), PRF does not contain anticoagulants, which allows for a slow, sustained release of growth factors essential for tissue regeneration. Below is the process for obtaining both i-PRF and A-PRF:

1. Blood Collection

- **Volume**: 10 to 60 milliliters depending on the area to be treated.
- **Preparation**: Blood is drawn using sterile techniques to minimize infection risk.

2. Centrifugation Process

- **i-PRF**: Low-speed centrifugation (700–1000 RPM) for 6 minutes results in a viscous, gel-like product rich in platelets, white blood cells, and fibrin (Bhoite KS et al. 2022).
- **A-PRF**: A slower centrifugation speed (1300 RPM) for 5 minutes produces a denser fibrin matrix with a higher concentration of leukocytes (Figueroa et al., 2020).

3. Harvesting the PRF Layer

The middle layer, rich in platelets and fibrin, is carefully harvested for injection.

4. Injection Process

PRF is injected into the treatment area, typically the scalp for hair regrowth.

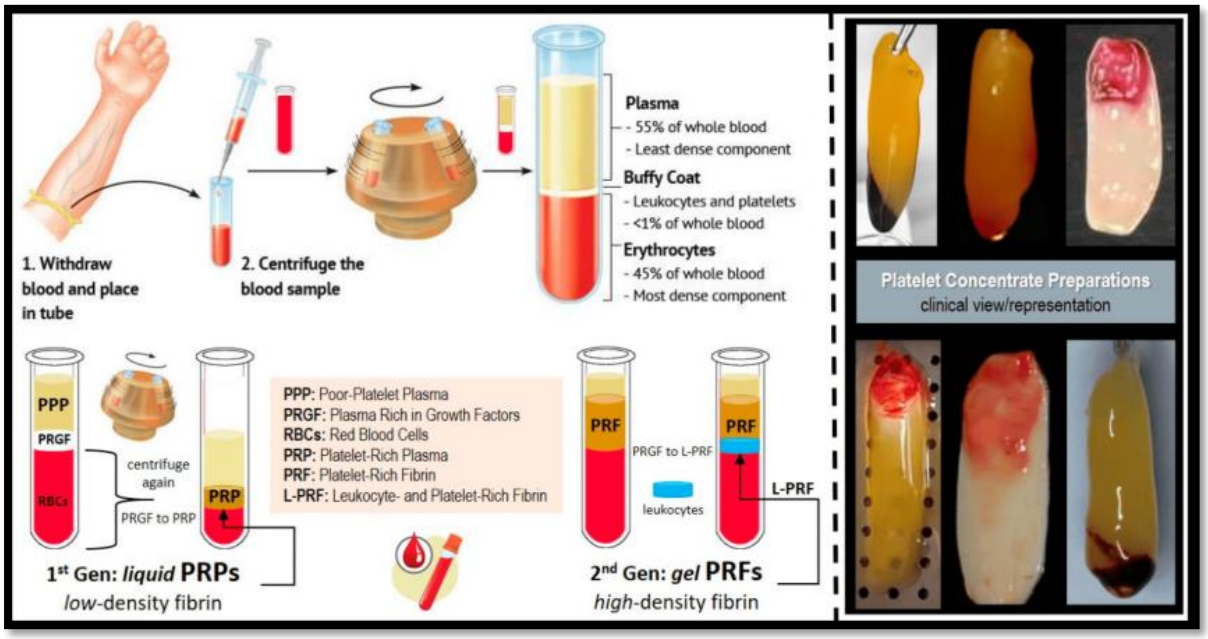

Figure I: clinical illustration/presentation of Injectable platelet-rich fibrin (I-PRF) and leukocyte and advanced platelet-rich fibrin (A-PRF) preparations (membranes).

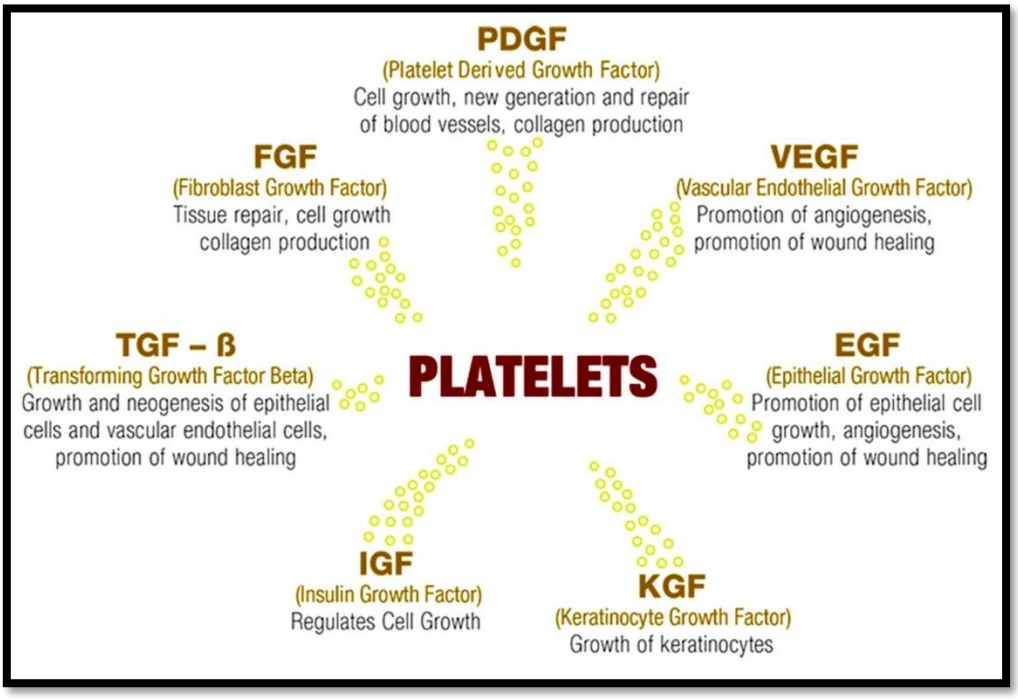

Figure II: illustration shows platelets contain various growth factors.

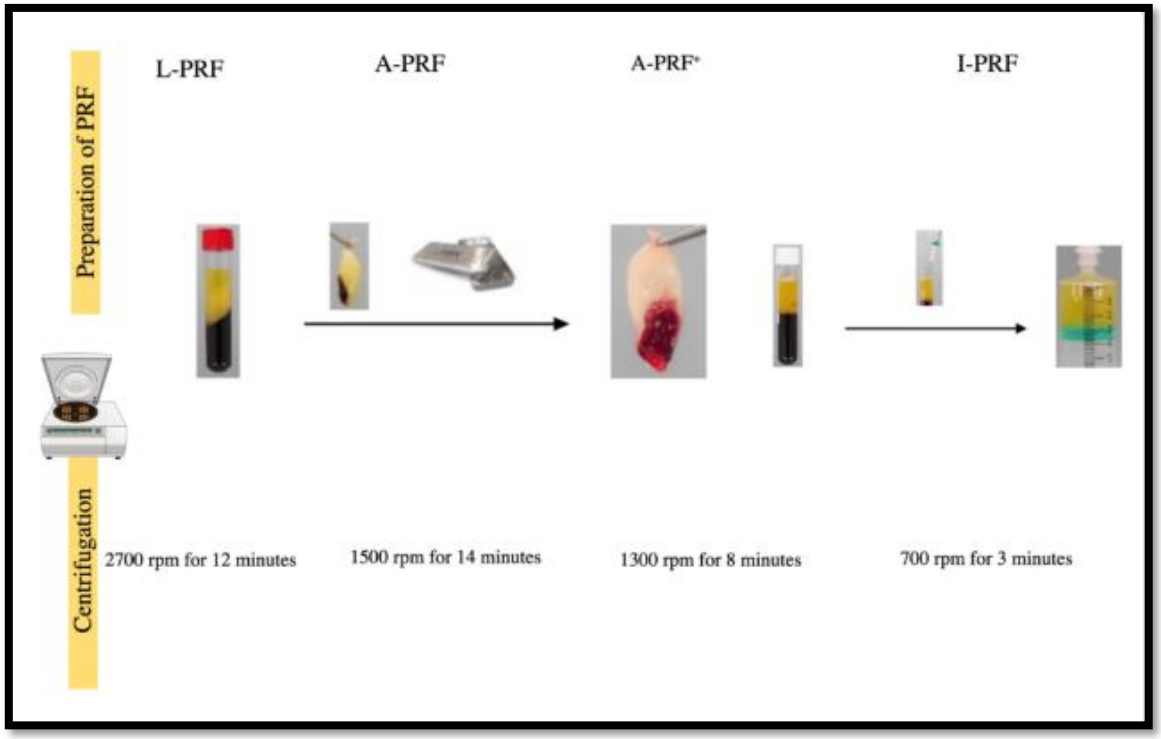

Figure III: Types of PRF preparation,PRF: platelet-rich fibrin, L-PRF: leukocyte and platelet-rich fibrin, A-PRF: advanced platelet-rich fibrin, A-PRF+: similar to A-PRF but with reducing the speed and time which leads to PRF richer in growth factors, I-PRF: injectable platelet-rich fibrin, rpm: revolutions per minute.

Figure IV: Demonstration of the non-invasive injection process of i-PRF and A-PRF for hair restoration.

Mechanisms of Action

Both i-PRF and A-PRF have multifactorial mechanisms that contribute to hair regrowth in AGA:

- **Increased Circulation**: Both therapies enhance blood flow to hair follicles, improving nutrient and oxygen delivery (Zhao et al., 2020).

- **Activation of Dermal Papilla Cells**: Stimulates the growth phase of the hair cycle by activating dermal papilla cells (Anitua et al., 2020).
- **Follicular Miniaturization Inhibition**: Counteracts the miniaturization of hair follicles by providing regenerative signals (Sanz et al., 2019).
- **Collagen Synthesis**: Promotes scalp health by encouraging collagen production (González et al., 2021).

Clinical Efficacy

Numerous studies support the effectiveness of i-PRF and A-PRF in the treatment of AGA. For example, Fukuoka et al. (2020) demonstrated a significant increase in hair follicle density following i-PRF treatment. Similarly, Khatri et al. (2021) observed notable improvements in hair regrowth and thickness following A-PRF treatment.

Both PRP and PRF are platelet concentrates; however, double centrifugation processes, the addition of anticoagulants. PRF is one such platelet concentrate which requires one spin and does not use anticoagulants for its procurement. Its three-dimensional fibrin network mimics the extracellular matrix in terms of its structure, which creates the environment for cells to function optimally

Advantages of i-PRF and A-PRF

- **Minimal Side Effects**: Being autologous treatments, both therapies carry a low risk of allergic reactions or infection transmission (Marx et al., 2019).
- **Non-Invasive**: No surgical procedures are required, making these treatments minimally invasive (Zhao et al., 2020).
- **Sustained Results**: The regenerative effects of i-PRF and A-PRF can provide lasting benefits, unlike medications that require continuous use (Figueroa et al., 2020).

II. Discussion

Hair loss is a significant stressor and a major cause of low self-esteem and depression. Androgenetic alopecia is the most common type of hair loss and occurs due to two primary causes, genetic predisposition and hormonal stimulation. A variety of biomaterials are routinely being utilized including barrier membranes, bone grafting materials, and bioactive growth factors to facilitate tissue regeneration. One such proposed method has been the use of platelet concentrates. Platelet rich plasma and platelet rich fibrin are two such modalities using supra-physiological doses of autologous growth factors derived from the patient's own blood to speed up the tissue regeneration.

There are various treatment options available to treat AGA, such as, hair transplant, medications such as finasteride, and Minoxidil with low-level laser light therapy. Most studies using PRP for hair growth have shown good results, but the emerging iPRF uses as a treatment modality needed to be quantitated against the former. Masuki *et al*.stated that A-PRF has a high concentration of white blood cells (WBCs) and platelets, whereas in PRP inflammatory cytokines were not present in high levels and there was no positive correlation between WBC counts and pro-inflammatory cytokine observed. Based on their study, authors concluded that i-PRF contains a higher amount of growth factors as compared to PRP, which not only functions as a scaffold but also a reservoir of growth factors. [(10)]

Choukroun and Ghanaati et al in their experimental study showed that low speed of centrifugation, just enough to separate platelets from red blood cells yields maximum results and a significantly higher number of leukocytes, platelets, and increase in growth factor concentration as compared to conventional PRF protocol. This new protocol also resulted in the generation of an injectable liquid PRF matrix (i-PRF) without the use of anticoagulants. Authors also claim that i-PRF prepared according to the low-speed centrifugation concept is highly enriched with platelets, leukocytes and provides an increased concentration of growth factors (vascular endothelial growth factor [VEGF] and transforming growth factor-β1) which are very much required for neovascularization and angiogenesis. A-PRF and i-PRF contain monocytes which play an essential role on bone growth, vascularization, and production of VEGF. The monocytes have BMP receptors and produce BMP-2.[(11)]

III. Conclusion

Injectable platelet-rich fibrin (i-PRF) and Advanced platelet-rich fibrin (A-PRF) offer promising new approaches for treating androgenetic alopecia by stimulating hair regrowth and improving scalp health. Both therapies utilize autologous platelet-rich products that enhance circulation, activate dermal papilla cells, and reduce inflammation, ultimately promoting hair follicle regeneration. While clinical evidence supports their efficacy, further studies are needed to refine treatment protocols and optimize their use for different stages of AGA.

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