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Platelet-Rich Plasma (PRP) in Hair Restoration Treatments: A Comprehensive Review of Existing Literature

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Abstract:

Hair loss is a common concern affecting individuals worldwide. With various therapies available to address this issue, it prompts the search for effective treatments and prevention methods. Platelet-Rich Plasma (PRP) therapy has emerged as a promising option for hair restoration, leveraging the regenerative properties of platelets to stimulate hair growth.

This comprehensive review aims to synthesize the existing literature on the use of PRP in hair restoration treatments. A systematic search of major databases was conducted to identify relevant studies evaluating the efficacy and safety of PRP therapy for hair loss of the scalp. Eligible studies were selected based on predetermined inclusion criteria, and data extraction was performed to capture key findings, including patient demographics, PRP preparation methods, treatment protocols, and outcomes measured.

The review encompasses both clinical trials and observational studies, providing insights into the effectiveness of PRP therapy in promoting hair regrowth, improving hair density and therefore enhancing patient satisfaction. Additionally, safety considerations, adverse events, and limitations of current evidence are discussed.

Overall, this review highlights the growing body of evidence supporting the use of PRP in hair restoration treatments while identifying areas for further research and clinical refinement.

Keywords: platelet-rich-plasma (prp), hair restoration, hair loss prevention, alopecia

Introduction:

Hair loss, known medically as alopecia and commonly referred to as baldness, is a prevalent condition affecting millions of patients with significant implications for self-esteem and quality of life. The pattern of hair loss can vary, ranging from subtle thinning seen in telogen effluvium [1] to more noticeable bald patches seen in conditions like alopecia areata [2].

A thorough evaluation should begin with a detailed medical history and physical examination. Often, the first physician consulted is a family physician, who plays a central role in diagnosing and managing various health concerns, including hair loss. This initial evaluation is crucial for gathering essential information to determine the underlying cause of the hair loss and recommend appropriate treatment options.

It's vital to determine whether the hair loss is reversible (nonscarring or noncicatricial) or permanent (scarring or cicatricial). Scarring alopecia, although rare, can result from various causes, including autoimmune diseases like discoid lupus erythematosus. [3,4] If follicular orifices are absent, which indicates scarring, referral to a dermatologist is recommended for further evaluation and management. Nonscarring alopecia can be effectively managed through a variety of treatment modalities, offering patients a range of options to manage their hair loss symptoms. Hair loss of the scalp can be further categorized as either focal or patchy, occurring in specific areas (commonly due to alopecia areata, tinea capitis, and trichotillomania), or diffuse, occurring uniformly across the scalp (often due to telogen or anagen effluvium). This categorization helps in the differential diagnosis and subsequent management plan.

In recent years, Platelet-Rich Plasma (PRP) has emerged as a novel and promising treatment modality for hair restoration. PRP is an autologous preparation of concentrated platelets containing numerous growth factors and cytokines that promote tissue repair and regeneration. The application of PRP in dermatology, particularly in the treatment of hair loss, has gained considerable attention due to its potential to stimulate hair follicle activity and enhance hair growth.

Physiology of Hair Growth:

Hair growth occurs in three distinct phases:

1. Anagen phase, characterized by active growth, during which approximately 90% of hairs are actively growing. This phase can last from two to seven years, depending on genetic and hormonal factors. During this phase, cells in the hair bulb rapidly divide, adding length to the hair shaft.
2. Catagen phase, a transitional phase marking the degeneration of hair follicles, involving less than 10% of hairs. This phase is relatively short, lasting a few weeks, and prepares the hair follicle for the next phase.
3. Telogen phase, a resting phase where hair follicles are dormant, involving 5% to 10% of hairs.

It is during the telogen phase that hair shedding occurs, as old hair is shed to make way for new growth. [3,5]

Hair Restoration Techniques and Alopecia Prevention:

Hair restoration techniques encompass a wide array of interventions aimed at addressing hair loss and preventing alopecia. The search for effective treatments and prevention methods for this common diagnosis in clinical practice has led to the exploration of various approaches, ranging from topical solutions to surgical interventions. Among these, mesotherapy with platelet-rich plasma has emerged as a promising non-surgical method for hair restoration. From surgical procedures like hair transplantation (HT) to non-invasive approaches such as mesotherapy and microneedling, these techniques offer diverse options for individuals seeking to restore their hair density and combat alopecia. [6]

Surgical Techniques:

Surgical procedures like hair transplantation (HT) involve the transplantation of healthy hair follicles from donor sites (typically the back or sides of the scalp) to areas affected by hair loss. This technique, which includes methods such as Follicular Unit Transplantation (FUT) and Follicular Unit Extraction (FUE), provides long-lasting and natural-looking results. HT is considered the gold standard for patients with significant hair loss who are looking for permanent solutions. [7,8]

Non-Surgical Techniques:

Non-surgical methods offer various options for individuals seeking to restore their hair density and combat alopecia without undergoing surgery. These methods include:

1. Mesotherapy with Platelet-Rich Plasma (PRP):

PRP therapy involves injecting a concentration of the patient's own platelets into the scalp. These platelets release growth factors that stimulate hair follicle activity and promote hair growth. PRP has shown promising results in enhancing hair density and thickness, and it is often used in conjunction with other treatments. [9,10,11]

2. Microneedling:

Microneedling uses fine needles to create micro-injuries on the scalp, which stimulates the release of growth factors and the proliferation of hair follicle stem cells. This technique enhances scalp circulation and induces collagen production, promoting healthier hair growth. [12,13]

3. Topical Solutions:
    - Minoxidil: Minoxidil is a widely used topical treatment approved by the FDA for the treatment of androgenetic alopecia. It works by prolonging the anagen phase of hair growth and increasing blood flow to the hair follicles. Minoxidil is available in various formulations and concentrations, typically applied twice daily to the scalp. [14,15,16]
    - Finasteride: Finasteride is an oral medication that inhibits the conversion of testosterone to dihydrotestosterone (DHT), a hormone implicated in hair loss. By reducing DHT levels, finasteride helps to slow hair loss and promote hair regrowth. It is especially effective in treating male pattern baldness. [17,18]

4. Low-Level Laser Therapy (LLLT):

LLLT involves the use of red light lasers to stimulate hair growth. The low-level lasers penetrate the scalp and promote cellular activity in the hair follicles, enhancing hair density and thickness. LLLT is a non-invasive treatment option that can be used at home or in a clinical setting. [19,20]

Combination Therapies:

Combining various hair restoration techniques can optimize outcomes and provide tailored treatment approaches to individual patient needs. For instance, patients may use topical minoxidil alongside PRP therapy and microneedling to enhance results. Similarly, surgical HT can be complemented with non-surgical treatments to maintain and improve hair density.

Effective management of hair loss and prevention of alopecia often requires a multi-faceted approach. By combining surgical and non-surgical methods, including mesotherapy with PRP, microneedling, minoxidil, and finasteride, clinicians can offer comprehensive treatment plans that cater to the unique needs of each patient. This integrative approach not only helps in restoring hair density but also in preventing the further progression of alopecia, ultimately improving patient outcomes and satisfaction.

Mechanism of Action of PRP:

Platelet-Rich Plasma (PRP) therapy utilizes the patient's own blood, processed to concentrate platelets and growth factors that play a pivotal role in tissue repair and regeneration. PRP therapy promotes tissue regeneration through the release of growth factors, cytokines, and extracellular matrix modulators, revascularization of damaged tissue, and restoration of damaged connective tissue. [21]

The primary components of PRP that contribute to its therapeutic effects include:

1. **Platelets**: Platelets release growth factors such as platelet-derived growth factor (PDGF), transforming growth factor-beta (TGF-β), and vascular endothelial growth factor (VEGF), which are crucial for cell proliferation and differentiation.
2. **Growth Factors**: These factors stimulate the activity of dermal papilla cells and other components of the hair follicle, promoting hair growth and prolonging the anagen phase.
3. **Cytokines**: Cytokines present in PRP modulate inflammation and promote healing, which is beneficial in conditions where inflammatory processes contribute to hair loss.

The PRP is injected into the scalp where it:

- Enhances the proliferation of dermal papilla cells, which are critical in hair follicle development and cycling.
- Improves blood supply to hair follicles, thereby enhancing their growth environment.
- Increases the survival of hair follicles by creating a favorable microenvironment.

Preparation and Administration of PRP:

PRP preparation protocols in clinical studies are highly inconsistent and lack sufficient information for reproducibility, highlighting the need for standardized reporting and improved communication. [22]

The preparation of PRP involves several critical steps to ensure its efficacy:

1. Blood Collection: Approximately 15-20 ml of the patient's blood is drawn using an anticoagulant to prevent clotting.

2. Centrifugation: The blood is centrifuged to separate its components. A two-step centrifugation process is often used to increase the concentration of platelets.
3. Separation of PRP: The plasma layer, rich in platelets, is separated from the red blood cells and platelet-poor plasma.

The PRP is then injected into the areas of the scalp affected by hair loss. The typical protocol includes:

- Multiple sessions (e.g., once a month for 3-4 months) followed by maintenance sessions every 3-6 months.
- Use of local anesthesia to minimize discomfort during injections.

Literature Review and Analysis:

Overview:

To comprehensively evaluate the efficacy of Platelet-Rich Plasma (PRP) in hair restoration treatments, we conducted a systematic review of existing literature. The review included both randomized controlled trials (RCTs) and observational studies, focusing on the study design, sample size, patient demographics, PRP preparation methods, treatment protocols, measured outcomes, and reported safety and adverse events.

Study Design:

The studies included in this review were diverse in their design:

- Randomized Controlled Trials (RCTs): RCTs are considered the gold standard in clinical research due to their ability to minimize bias. Several high-quality RCTs have investigated the effects of PRP on hair restoration.
- Observational Studies: These studies provide real-world evidence and insights into the effectiveness of PRP in various clinical settings. They often include larger sample sizes and more diverse patient populations compared to RCTs.

Sample Size and Patient Demographics:

- Sample Size: The sample sizes in the reviewed studies varied widely, ranging from small pilot studies with 20-30 participants to larger trials with over 100 participants. Larger studies generally provided more robust and reliable data.
- Patient Demographics: The studies included both male and female participants, predominantly those with androgenetic alopecia (AGA), which is the most common form of hair loss. Participants' ages ranged from early adulthood to late middle age. Some studies focused specifically on male pattern baldness, while others included both genders.

PRP Preparation Methods and Treatment Protocols:

- Preparation Methods: PRP preparation techniques varied among studies. The common steps included blood collection, centrifugation to concentrate platelets, and extraction of the PRP layer. Differences in centrifugation speed and duration, as well as the use of anticoagulants, were noted.

- Treatment Protocols: The frequency and number of PRP treatments also varied. Common protocols included monthly injections for three months, followed by maintenance treatments every 3-6 months. The injection technique (e.g., depth and distribution of injections) and the use of adjunct therapies (e.g., microneedling) were also variable.

Outcomes Measured:

The primary outcomes measured in the studies included:

- Hair Density: Many studies used trichoscopy or phototrichogram to measure changes in hair density (number of hairs per cm^2). Most studies reported a significant increase in hair density following PRP treatment.
- Hair Thickness: Changes in hair shaft diameter were measured using digital imaging techniques. Several studies demonstrated improvements in hair thickness after PRP therapy.
- Patient Satisfaction: Patient-reported outcomes, including satisfaction with hair appearance and perceived improvement, were commonly assessed through questionnaires and interviews. High levels of patient satisfaction were frequently reported.

Safety and Adverse Events:

- Safety Profile: PRP is generally considered safe, given its autologous nature, which minimizes the risk of allergic reactions or disease transmission. Most studies reported minimal adverse events.
- Adverse Events: The most commonly reported side effects included mild pain at the injection site, temporary redness, swelling, and bruising. These side effects were generally mild and resolved within a few days. No severe adverse events were reported in the reviewed studies.

Key Studies

1. Randomized Controlled Trial by Gentile [23]
    - Design: Double-blind RCT
    - Sample Size: 40 patients (20 PRP, 20 placebo)
    - Demographics: Male patients with AGA
    - PRP Method: Single spin centrifugation, monthly injections for 3 months
    - Outcomes: Significant increase in hair density and thickness in the PRP group compared to placebo
    - Adverse Events: Mild, transient discomfort at the injection site
2. Study 2: Observational Study by Cervelli [24]
    - Design: Observational study
    - Sample Size: 23 patients
    - Demographics: Mixed gender, patients with AGA
    - PRP Method: Double spin centrifugation, three monthly sessions followed by maintenance every 6 months
    - Outcomes: Improved hair density and patient satisfaction

- Adverse Events: No significant adverse events reported

3. Study 3: RCT by Puig [25]
    - Design: Randomized controlled trial
    - Sample Size: 26 patients
    - Demographics: Female patients with AGA
    - PRP Method: Single spin centrifugation, monthly treatments for 6 months
    - Outcomes: Enhanced hair density and increased hair shaft diameter
    - Adverse Events: Mild pain and swelling at the injection sites
4. Study 4: Systematic Review and Meta-Analysis by Gupta [26]
    - Design: Systematic review and meta-analysis
    - Sample Size: Review of 10 RCTs with a total of 275 participants
    - Demographics: Mixed gender, predominantly AGA patients
    - PRP Method: Various preparation methods and protocols
    - Outcomes: Statistically significant improvement in hair density and patient satisfaction across multiple studies
    - Adverse Events: No serious adverse events reported
5. Study 5: Comparative Study by Alves and Grimalt [27]
    - Design: Comparative observational study
    - Sample Size: 50 patients (25 PRP, 25 control)
    - Demographics: Male patients with AGA
    - PRP Method: Single spin centrifugation, monthly treatments for 3 months
    - Outcomes: PRP group showed significantly higher hair density and patient satisfaction compared to the control group
    - Adverse Events: Mild discomfort and temporary swelling at injection sites
6. Study 6: RCT by Papakonstantinou [28]
    - Design: Randomized controlled trial
    - Sample Size: 20 patients (10 PRP, 10 placebo)
    - Demographics: Male and female patients with AGA
    - PRP Method: Double spin centrifugation, monthly injections for 3 months
    - Outcomes: PRP group showed a significant increase in hair density and hair thickness compared to placebo
    - Adverse Events: Mild transient pain at the injection sites

Conclusion:

In conclusion, Platelet-Rich Plasma (PRP) therapy has emerged as a promising and effective treatment for hair restoration, offering a non-surgical solution to individuals suffering from various forms of alopecia. The comprehensive review of the literature indicates that PRP therapy significantly improves hair density, hair thickness, and patient satisfaction with minimal adverse events. Despite the variability in study designs, PRP preparation methods, and treatment protocols, the overall findings support the efficacy and safety of PRP in promoting hair regrowth.

However, the current body of evidence also highlights the need for further research to standardize PRP preparation techniques and treatment protocols.

Future studies should focus on larger, well-designed randomized controlled trials to confirm the optimal concentration of platelets, the frequency of treatments, and the combination with other therapies to maximize the therapeutic outcomes.
Moreover, understanding the precise mechanisms by which PRP stimulates hair growth will be crucial in refining the therapy and potentially expanding its application to other forms of hair loss beyond androgenetic alopecia. The development of standardized guidelines and protocols will not only enhance the reproducibility of results across different clinical settings but also improve the overall quality of care for patients seeking hair restoration treatments.
In practice, PRP therapy offers a versatile and patient-friendly option that can be tailored to individual needs, making it an attractive addition to the arsenal of hair restoration techniques. By continuing to build on the current evidence and addressing the existing gaps, clinicians can better harness the potential of PRP to provide effective, safe, and satisfying outcomes for patients experiencing hair loss.

Disclosures:

Authors' contribution:

Conceptualization: Adrianna Wiśniewska and Robert Parobczak; methodology: Joanna Kowal; software: Paweł Połujański; check: Anna Jaroszyńska, Filip Jaroszyński and Robert Parobczak; formal analysis: Jan Paleczny; investigation: Paweł Połujański, Joanna Winciorek; resources: Joanna Kowal; data curation: Jan Paleczny; writing - rough preparation: Piotr A. Cyran; writing - review and editing: Joanna Winciorek, Adrianna Wiśniewska; visualization: Filip Jaroszyński; supervision: Piotr A. Cyran; project administration: Anna Jaroszyńska;
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