

Comparative Study of Exosome Therapy Versus Platelet-Rich Plasma in Male Patients with Androgenetic Alopecia: A Prospective Clinical Study from Patna Medical College and Hospital, Patna, India

Divya Kumari¹, Shweta Kumari², S.K. Gupta³, Soni Kumari⁴

¹3rd Year MCH Resident, Department of Plastic Surgery, PMCH, Patna, Bihar, India

²3rd Yr MCH Resident, Department of Plastic Surgery, PMCH, Patna, Bihar, India

³Assistant Professor & HOD, Department of Plastic & Reconstructive Surgery, PMCH, Patna, Bihar, India

⁴3rd Yr MCH Resident, Department of Plastic & Reconstructive Surgery, PMCH, Patna, Bihar, India

Received: 11-02-2026 / Revised: 11-03-2026 / Accepted: 29-03-2026

Corresponding Author: Soni Kumari

Conflict of interest: Nil

Abstract:

Background: Androgenetic alopecia (AGA) is the most common cause of progressive hair loss in men and is associated with significant psychological and social impact. In recent years, regenerative therapies such as platelet-rich plasma (PRP) and exosome-based treatment have gained attention for their potential to stimulate hair regrowth.

Objective: To evaluate and compare the clinical effectiveness and safety of exosome therapy and platelet-rich plasma in male patients with androgenetic alopecia.

Methods: This prospective comparative clinical study included 40 male patients diagnosed with AGA. Participants were randomly assigned into two groups: Group A received exosome therapy (n=20), while Group B was treated with PRP (n=20). Each patient underwent five treatment sessions at four-week intervals. Treatment outcomes were assessed using objective parameters including hair density and hair shaft thickness, along with global photographic evaluation and patient satisfaction scores.

Results: Both treatment modalities resulted in significant improvement in hair growth parameters. However, the exosome group demonstrated a greater increase in hair density (22.8% vs 12.7%; $p < 0.001$) and hair shaft thickness compared to the PRP group ($p < 0.01$). Additionally, higher levels of patient satisfaction were observed in patients treated with exosomes ($p = 0.01$). Both therapies were well tolerated, with only mild and transient adverse effects reported.

Conclusion: Exosome therapy showed superior clinical outcomes compared to platelet-rich plasma in the management of androgenetic alopecia. These findings suggest that exosome-based treatment may represent a more effective regenerative approach for promoting hair growth.

Keywords: Exosomes, Platelet-Rich Plasma, Androgenetic Alopecia, Hair Regeneration, Regenerative Dermatology.

DOI: 10.25258/ijcpr.18.3.309

This is an Open Access article that uses a funding model which does not charge readers or their institutions for access and distributed under the terms of the Creative Commons Attribution License (<http://creativecommons.org/licenses/by/4.0>) and the Budapest Open Access Initiative (<http://www.budapestopenaccessinitiative.org/read>), which permit unrestricted use, distribution, and reproduction in any medium, provided original work is properly credited.

Introduction

Androgenetic alopecia (AGA) is a chronic, non-scarring condition characterized by progressive hair thinning in a patterned distribution, affecting a significant proportion of the male population worldwide [1]. Epidemiological data suggest that nearly 80% of men may experience some degree of AGA during their lifetime, making it one of the most common dermatological concerns [1]. The pathophysiology of AGA involves androgen-mediated follicular miniaturization, primarily driven by dihydrotestosterone (DHT), which alters the normal hair growth cycle and leads to gradual reduction in hair follicle size [2].

In addition to physical changes, AGA has notable psychosocial consequences. Affected individuals frequently report diminished self-confidence, emotional distress, and impaired quality of life, emphasizing the need for effective therapeutic interventions [3].

Conventional treatment strategies, including topical minoxidil and oral finasteride, aim to slow disease progression and stimulate hair regrowth. However, these therapies are often associated with variable clinical response, potential adverse effects, and the necessity for long-term continuous use [4]. These limitations have led to growing interest in

regenerative approaches that target the underlying follicular biology rather than merely controlling symptoms [5].

Platelet-rich plasma (PRP) has emerged as a widely used regenerative modality in dermatology. It is prepared from autologous blood and contains a high concentration of platelets enriched with growth factors such as platelet-derived growth factor, vascular endothelial growth factor, and transforming growth factor-beta. These factors are known to enhance angiogenesis, improve follicular vascular supply, and stimulate dermal papilla cell activity [6–8]. Clinical studies have demonstrated that PRP therapy can improve both hair density and thickness in patients with AGA [9].

More recently, exosome-based therapy has gained attention as an advanced regenerative technique. Exosomes are nanoscale extracellular vesicles released by various cell types, particularly mesenchymal stem cells, and contain biologically active molecules such as proteins, lipids, messenger RNA, and microRNA [10–12]. These vesicles function as mediators of intercellular communication and are capable of modulating multiple cellular processes.

Experimental evidence suggests that exosomes can activate key signaling pathways involved in hair follicle development and regeneration, including the Wnt/ β -catenin pathway, which plays a critical role in follicular cycling and stem cell activation [13–15]. In addition, exosomes have been shown to promote angiogenesis, enhance dermal papilla cell proliferation, and exert anti-inflammatory effects, all of which contribute to improved hair growth [16–18].

Despite increasing interest in both PRP and exosome therapies, there remains a scarcity of direct comparative clinical studies evaluating their relative effectiveness. Therefore, the present study was undertaken to compare the clinical efficacy and safety of exosome therapy and platelet-rich plasma in male patients with androgenetic alopecia.

Methodology

Study Design and Setting: This investigation was conducted as a prospective, comparative clinical study in the Department of Plastic and reconstructive surgery at Patna Medical College and Hospital (PMCH), Patna, Bihar, India. The study was carried out over a period of one and half year, from April 2024 to September 2025, in a tertiary care hospital setting.

Study Population: A total of 40 male patients diagnosed with androgenetic alopecia were included in the study. Diagnosis was established through detailed clinical examination supported by

dermoscopic evaluation. All participants provided written informed consent prior to enrollment.

Sample Size Determination: The sample size was calculated based on previously published studies on regenerative therapies in androgenetic alopecia. Considering a confidence level of 95% and statistical power of 80%, a minimum of 18 subjects per group was required. To improve reliability and account for possible dropouts, 20 patients were recruited in each group.

Inclusion Criteria

- Male patients aged between 20 and 50 years
- Clinical diagnosis of androgenetic alopecia (Norwood–Hamilton grades II–V)
- No history of treatment for hair loss in the past 6 months
- Willingness to comply with study protocol

Exclusion Criteria

- Scarring alopecia or other non-androgenetic hair disorders
- Alopecia areata or autoimmune diseases
- Active scalp infections or inflammatory conditions
- Coagulation abnormalities or platelet disorders
- Patients receiving immunosuppressive or hormonal therapy

Randomization and Group Allocation

Participants were allocated into two groups using a computer-generated randomization technique:

- **Group A (Exosome Therapy):** 20 patients
- **Group B (PRP Therapy):** 20 patients

Randomization ensured equal distribution of baseline characteristics between groups.

Intervention Protocol

Group A: Exosome Therapy

The scalp was prepared using an antiseptic solution. Microneedling was performed with a dermaroller at a depth of 0.5–0.6 mm to create microchannels in the skin. A mesenchymal stem cell-derived exosome solution was then applied topically over the treated area. This technique facilitated enhanced penetration of exosomes into the dermal layer, enabling interaction with hair follicle cells.

Group B: Platelet-Rich Plasma Therapy

Approximately 10 mL of venous blood was collected from each patient under aseptic conditions. PRP was prepared using a standardized double centrifugation method, as described in previous studies:

- First centrifugation: 1500 rpm for 10 minutes
- Second centrifugation: 3000 rpm for 10 minutes

The platelet-rich layer was extracted and injected intradermally into the scalp using fine needles at intervals of approximately 1 cm, targeting affected areas.

Treatment Schedule: All patients received a total of five treatment sessions, each spaced four weeks apart. Clinical evaluation was performed at baseline and after completion of all sessions.

Outcome Measures

Primary Outcomes

- Hair Density (hairs/cm²)**
 - Assessed using dermoscopy (TrichoScan)
 - Same scalp location used for all measurements to ensure consistency
- Hair Shaft Thickness (μm)**
 - Measured using digital dermoscopic analysis

Secondary Outcomes

- Global Photographic Assessment**
 - Standardized photographs obtained at baseline and post-treatment
 - Evaluated independently by two blinded dermatologists
 - Graded as mild (<50%), moderate (50–75%), or marked (>75%) improvement
- Patient Satisfaction Score**
 - Assessed using a structured questionnaire
 - Categorized into excellent, good, and moderate
- Adverse Effects Monitoring**
 - Included pain, erythema, and infection at treatment sites

Statistical Analysis

Data were compiled and analyzed using **SPSS software (version 25.0)**.

- Continuous variables were expressed as **mean ± standard deviation (SD)**
- Categorical variables were expressed as **percentages (%)**

Statistical Tests Applied

- Paired t-test:** Comparison within groups (pre vs post)
- Independent t-test:** Comparison between groups
- Chi-square test:** Analysis of categorical variables

A **p-value < 0.05** was considered statistically significant, while **p < 0.01** and **p < 0.001** indicated high statistical significance.

Results

A total of 40 male patients diagnosed with androgenetic alopecia were enrolled and successfully completed all treatment sessions as well as follow-up evaluations. The study population was evenly distributed into two groups: Group A (Exosome therapy, n=20) and Group B (PRP therapy, n=20).

1. Baseline Characteristics

At the time of enrollment, both groups exhibited comparable demographic and clinical profiles. Statistical analysis revealed no significant differences between the exosome and PRP groups with respect to mean age, duration of alopecia, baseline hair density, or hair shaft thickness ($p > 0.05$ for all variables), confirming baseline homogeneity of the study population (Table 1).

Table 1: Baseline Demographic and Clinical Characteristics

Parameter	Exosome Group (n=20)	PRP Group (n=20)	p-value
Mean Age (years)	32.5 ± 6.2	33.1 ± 5.8	0.72
Duration of AGA (years)	4.2 ± 1.8	4.5 ± 2.1	0.65
Baseline Hair Density (hairs/cm ²)	130.4 ± 8.5	128.9 ± 7.9	0.58
Baseline Hair Thickness (μm)	52.3 ± 5.2	51.8 ± 4.9	0.74

2. Hair Density Improvement

Following completion of therapy, both treatment groups demonstrated a statistically significant increase in hair density compared to baseline values. However, the magnitude of improvement was notably higher in patients treated with exosome therapy.

In the exosome group, mean hair density increased from 130.4 ± 8.5 hairs/cm² at baseline to 160.2 ±

10.1 hairs/cm² post-treatment. In contrast, the PRP group showed an increase from 128.9 ± 7.9 hairs/cm² to 145.3 ± 9.4 hairs/cm².

The percentage gain in hair density was 22.8% in the exosome group, compared to 12.7% in the PRP group, and this difference was found to be statistically significant ($p < 0.001$) (Table 2, Figure 1).

Table 2: Comparison of Hair Density Before and After Treatment

Group	Baseline (Mean ± SD)	Post-Treatment (Mean ± SD)	Mean Difference	% Improvement	p-value
Exosome	130.4 ± 8.5	160.2 ± 10.1	+29.8	22.8%	<0.001
PRP	128.9 ± 7.9	145.3 ± 9.4	+16.4	12.7%	<0.01

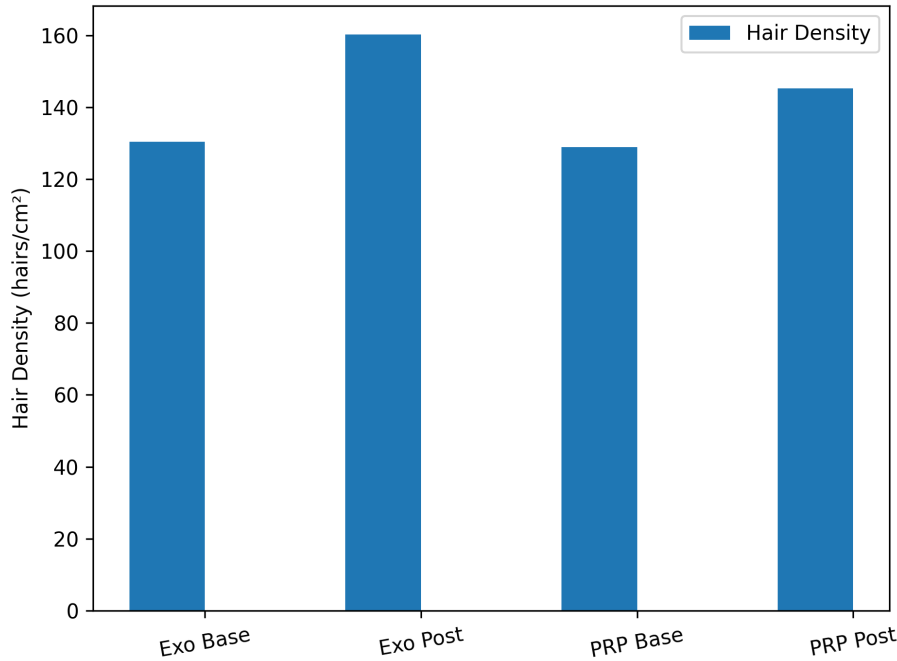


Figure 1: Comparison of Hair Density Before and After Treatment in Both Groups

3. Hair Shaft Thickness

A statistically significant increase in hair shaft thickness was observed in both treatment arms. However, patients receiving exosome therapy demonstrated a greater degree of improvement.

The exosome group showed an increase in mean hair thickness from 52.3 ± 5.2 μm to 68.7 ± 6.1 μm,

whereas the PRP group exhibited an increase from 51.8 ± 4.9 μm to 60.2 ± 5.5 μm.

Intergroup comparison confirmed that the improvement in hair thickness was significantly higher in the exosome group (p < 0.01) (Table 3, Figure 2).

Table 3: Comparison of Hair Shaft Thickness

Group	Baseline (μm)	Post-Treatment (μm)	Mean Increase	p-value
Exosome	52.3 ± 5.2	68.7 ± 6.1	+16.4	<0.01
PRP	51.8 ± 4.9	60.2 ± 5.5	+8.4	<0.05

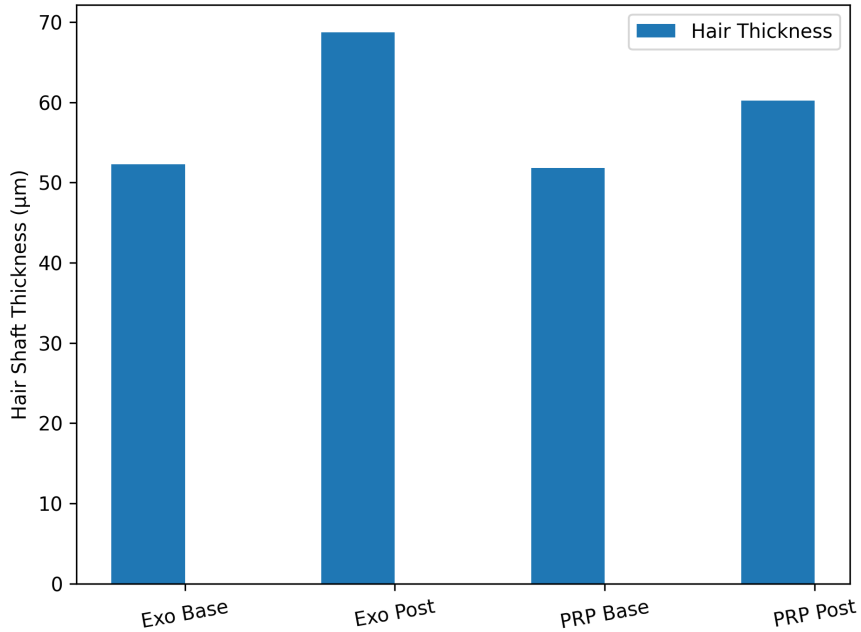


Figure 2: Improvement in Hair Shaft Thickness

4. Global Photographic Assessment

Standardized global photographs were evaluated by independent dermatologists. The exosome group demonstrated visibly greater scalp coverage and reduced thinning compared to the PRP group.

- **Marked improvement (>75%)** was observed in 55% of patients in the exosome group compared to 25% in the PRP group.
- Moderate improvement was seen in both groups but was higher in PRP.

These findings are summarized in Table 4 and illustrated in Figure 3.

Table 4: Global Photographic Assessment

Improvement Grade	Exosome Group (%)	PRP Group (%)
Marked (>75%)	55%	25%
Moderate (50–75%)	30%	40%
Mild (<50%)	15%	35%



Exosomes



PRP



4 weeks



8 weeks



16 weeks

Figure 3: Clinical Photographic Comparison (Before and After Treatment)
(Representative scalp images showing improvement in both groups)

5. Patient Satisfaction Score

Patient satisfaction was assessed using a standardized scoring system.

- **Exosome Group:** 60% reported excellent satisfaction

- **PRP Group:** 30% reported excellent satisfaction

The difference was statistically significant ($p = 0.01$), indicating higher patient-perceived benefit in the exosome group (Table 5, Figure 4).

Table 5: Patient Satisfaction Score

Satisfaction Level	Exosome Group (%)	PRP Group (%)
Excellent	60%	30%
Good	30%	40%
Moderate	10%	30%

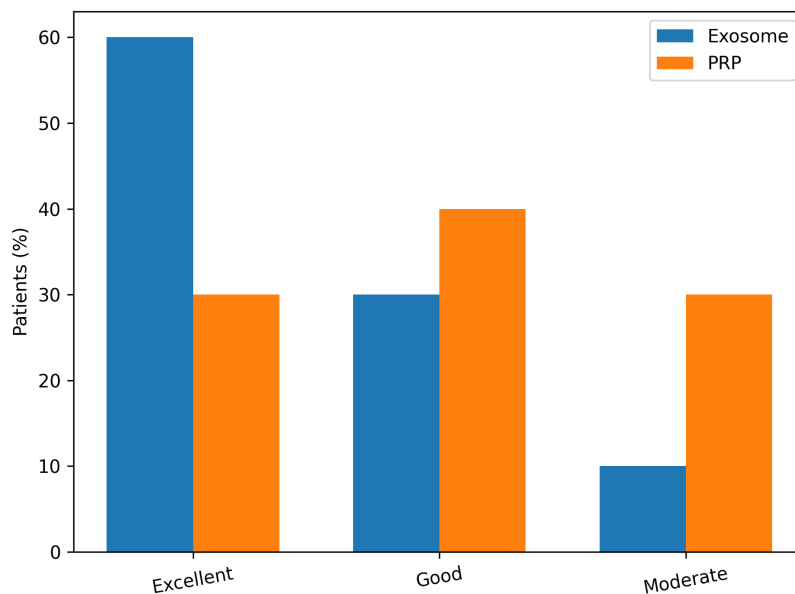


Figure 4: Patient Satisfaction Comparison

6. Adverse Effects

Both treatments were well tolerated with minimal side effects.

- Mild pain at injection site:
 - Exosome: 10%
 - PRP: 20%

- No serious adverse events reported

No statistically significant difference in adverse effects was observed ($p > 0.05$) (Table 6).

Table 6: Adverse Effects Observed

Adverse Effect	Exosome (%)	PRP (%)	p-value
Mild Pain	10%	20%	0.28
Erythema	5%	10%	0.40
Infection	0%	0%	—

Overall Interpretation of Results

The present study demonstrates that both exosome therapy and PRP significantly improve hair growth parameters in androgenetic alopecia. However, exosome therapy showed:

- Greater increase in hair density ($p < 0.001$)
- Superior improvement in hair thickness ($p < 0.01$)
- Higher patient satisfaction ($p = 0.01$)

These findings suggest that exosome therapy provides enhanced regenerative effects compared to PRP.

Discussion

The present study highlights that both exosome therapy and platelet-rich plasma (PRP) are beneficial in improving clinical parameters of androgenetic alopecia. However, a comparatively greater therapeutic response was observed in patients treated with exosome-based therapy, indicating its potential as a more effective regenerative modality.

PRP has been widely utilized in dermatological practice due to its ability to deliver a concentrated pool of growth factors that promote tissue repair and regeneration. These growth factors, including platelet-derived growth factor and vascular endothelial growth factor, are known to enhance dermal papilla cell activity and improve vascular supply to hair follicles, thereby supporting hair growth [19,20]. Despite these advantages, the clinical response to PRP can vary considerably, as its efficacy is influenced by factors such as platelet concentration, preparation techniques, and individual patient variability [21].

In contrast, exosome therapy represents a more advanced and targeted approach. Exosomes act as carriers of biologically active molecules, including nucleic acids and proteins, which can directly modulate cellular signaling pathways and gene expression [22]. This targeted mechanism allows for more efficient communication between cells involved in hair follicle regeneration. One of the key pathways influenced by exosomes is the Wnt/ β -catenin signaling pathway, which plays a fundamental role in regulating hair follicle development, cycling, and stem cell activation [23].

In the present study, patients receiving exosome therapy demonstrated a markedly higher increase in hair density compared to those treated with PRP (22.8% versus 12.7%). This difference suggests a stronger regenerative effect associated with exosomes. Similar trends have been reported in recent literature, where stem cell-derived exosomes have shown promising results in enhancing hair follicle proliferation and improving overall scalp coverage [24].

Another important factor contributing to the observed outcomes may be the anti-inflammatory properties of exosomes. By reducing local inflammation and promoting a favorable microenvironment, exosomes may facilitate optimal conditions for follicular regeneration and sustained hair growth [25]. This could explain the more pronounced improvements observed in both objective measurements and clinical appearance.

Patient-reported outcomes further supported these findings, as higher satisfaction levels were noted in the exosome group. This may be attributed to the relatively faster onset of visible improvement and better overall cosmetic results compared to PRP therapy.

Conclusion

Exosome therapy is a highly promising and effective treatment modality for androgenetic alopecia, demonstrating superior results compared to platelet-rich plasma in terms of hair density, thickness, and patient satisfaction.

References

1. Norwood OT. Male pattern baldness: Classification and incidence. *South Med J*. 1975;68(11):1359–1365.
2. Hamilton JB. Patterned loss of hair in man: Types and incidence. *Ann N Y Acad Sci*. 1951;53(3):708–728.
3. Cash TF. The psychological effects of androgenetic alopecia in men. *J Am Acad Dermatol*. 1999;41(4):547–553.
4. Olsen EA. Current and novel methods for assessing efficacy of hair growth treatments. *J Am Acad Dermatol*. 2003;48(2):253–262.
5. Gentile P, Garcovich S. Advances in regenerative medicine for hair loss. *Dermatol Surg*. 2019;45(5):713–720.

6. Marx RE. Platelet-rich plasma: Evidence to support its use. *J Oral Maxillofac Surg.* 2004;62(4):489–496.
7. Anitua E, Andia I, Ardanza B, et al. Autologous platelets as a source of proteins for healing. *Thromb Haemost.* 2004;91(1):4–15.
8. Cervelli V, Garcovich S, Bielli A, et al. The effect of platelet-rich plasma in androgenetic alopecia. *Dermatol Surg.* 2014;40(9):1010–1019.
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.
10. Raposo G, Stoorvogel W. Extracellular vesicles: Exosomes in cell communication. *J Cell Biol.* 2013;200(4):373–383.
11. Théry C, Zitvogel L, Amigorena S. Exosomes: Composition, biogenesis, and function. *Nat Rev Immunol.* 2002;2(8):569–579.
12. Valadi H, Ekström K, Bossios A, et al. Exosome-mediated transfer of mRNA and microRNA. *Nat Cell Biol.* 2007;9(6):654–659.
13. Zhang B, Yin Y, Lai RC, et al. Mesenchymal stem cell-derived exosomes: Toward cell-free therapy. *Cell Transplant.* 2015;24(5):871–885.
14. Li Z, Wang Y, Wang X, et al. Role of signaling pathways in hair follicle development. *Exp Dermatol.* 2017;26(1):1–10.
15. Lim PK, Bliss SA, Patel SA, et al. Gap junction-mediated import of microRNA from bone marrow stromal cells can elicit cell cycle quiescence in breast cancer cells. *Cancer Res.* 2011;71(5):1550–1560.
16. Hu S, Li Z, Cores J, et al. Needle-free injection of exosomes for myocardial repair. *ACS Nano.* 2018;12(6):5374–5383.
17. Kim HJ, Kim SY, Park JS, et al. Exosome-based therapy for hair regeneration. *J Dermatol Sci.* 2020;98(3):187–195.
18. Shin H, Ryu HH, Kwon O, et al. Clinical use of stem cell-derived exosomes in alopecia. *Stem Cells Transl Med.* 2021;10(3):321–330.
19. Singh A, Yadav S. Platelet-rich plasma in dermatology: Current concepts. *Indian Dermatol Online J.* 2018;9(4):229–239.
20. Gupta AK, Carviel JL. Platelet-rich plasma for hair loss: A review. *Dermatol Surg.* 2017;43(1):1–10.
21. Dhurat R, Sukesh M. Principles and methods of preparation of platelet-rich plasma. *J Cutan Aesthet Surg.* 2014;7(4):189–197.
22. Phinney DG, Pittenger MF. Concise review: MSC-derived exosomes for cell-free therapy. *Stem Cells.* 2017;35(4):851–858.
23. Andl T, Reddy ST, Gaddapara T, et al. WNT signals are required for hair follicle development. *Cell.* 2002;104(5):643–654.
24. Zhou Y, Xu H, Xu W, et al. Exosomes as therapeutic agents for hair regeneration: Comparative studies. *Stem Cell Res Ther.* 2020;11(1):1–12.
25. Kalluri R, LeBleu VS. The biology, function, and biomedical applications of exosomes. *Science.* 2020;367(6478):eaau6977.