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# The effect of autologous activated platelet-rich plasma injection on female pattern hair loss: A randomized placebo-controlled study

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## Summary

**Background:** Hair is an essential part of a woman's appearance and attractiveness. This is reflected in the predominantly psychological morbidity that can be associated with female pattern hair loss. Platelet-rich plasma(PRP) has been used in numerous fields of medicine. Recently, PRP has received growing attention as a potential therapeutic tool for hair loss.

**Objective:** To evaluate the efficacy and safety of autologous platelet-rich plasma in the treatment of female pattern hair loss.

**Materials and methods:** Thirty female patients with female pattern hair loss were randomly assigned to receive autologous PRP injection into a selected area, and another area was injected with normal saline as a placebo. Sessions were performed weekly for a maximum total of four sessions. Patients were followed up 6 months after the end of last session. The outcome was assessed both subjectively and objectively.

**Results:** There was a statistical significant difference between PRP and placebo areas ($P<.005$) regarding both hair density and hair thickness as measured by a folliscope. The hair pull test became negative in PRP-injected areas in 25 patients (83%) with average number of three hairs. Global pictures showed a significant improvement in hair volume and quality together with a high overall patient satisfaction in PRP-injected sites, and these results were maintained during the 6-month follow-up.

**Conclusion:** Platelet-rich plasma injections can be regarded as an alternative for the treatment of female pattern hair loss with minimal morbidity and a low cost-to-benefit ratio.

KEYWORDS
female pattern hair loss, hair pull test, platelet-rich plasma

## 1 | INTRODUCTION

Hair growth occurs in cycles of various phases: Anagen is the growth phase; catagen is the involuting or regressing phase; and telogen is the resting or quiescent phase. Female pattern hair loss (FPHL), or androgenetic alopecia (AGA), is the most common type of hair loss affecting women. It is characterized by progressive shortening of the duration of the growth phase of the hair with successive hair cycles, and progressive follicular miniaturization with conversion of terminal to vellus hair follicles (terminal hairs are thicker and longer, while

Key message: Evaluation of platelet-rich plasma in the treatment of female pattern hair loss.

  

vellus hairs are soft, fine, and short). Women who present to their doctor with a reduction in hair density often have thinning and widening of the area of hair loss on the central part of the scalp. The frontal hair line may or may not be preserved. Hair shedding can vary in intensity over time and from individual to individual. The onset of the hair loss may precede menarche in young women or occur as late as the sixth decade of life.[1–3]

Hair loss has a significant influence on psychological distress and is associated with low self-esteem and depression. The treatment modalities vary from medical treatment such as minoxidil, 5-alpha-reductase inhibitors, to surgical modality as hair transplantation. Although there are a wide range of treatment modalities, the results, cost, and associated side effects stand as an obstacle in continuation of the treatment. On the other hand, platelet-rich plasma (PRP) has shown remarkable beneficial effects without any major adverse reactions.[4]

Platelet-rich plasma (PRP) is an autologous concentration of human platelets contained in a small volume of plasma.[5] It has been investigated in several disciplines in medicine for its role in wound healing, especially in orthopaedics and dentistry. Recently, it has also been found to be beneficial in dermatology, for example, in acne scarring, wound healing, and fat transplantation. It has also been shown to promote hair survival and growth, both in vitro and in vivo.[6–8]

The basic idea behind PRP injection is to deliver high concentrations of growth factors to the scalp, with the hope of stimulating hair regrowth.[4] This prospective randomized placebo-controlled study was conducted to evaluate the efficacy and safety of autologous PRP in the treatment of female pattern hair loss.

## 2 | PATIENTS AND METHODS

This study was designed as a double-blinded randomized placebo-controlled study. Thirty female patients with female pattern hair loss were enrolled in the study. Their age ranged from 20 to 45 years. Patients, who had received topical or systemic treatments for hair loss in the previous 3 months, were excluded. Patients who are pregnant or those with a present history of keloids, malignancies, bleeding disorders, and thyroid dysfunction were also excluded. All the patients were recruited from National Institute of Laser Enhanced Sciences, Cairo University. Written and signed informed explanatory consent was obtained from all the patients before enrollment. This clinical study was conducted in accordance with the Helsinki Declaration of 1975.

Diagnosis of female pattern hair loss was made in all patients before treatment based on a detailed medical history (any drugs causing hair loss), menstrual history, family history, clinical examination, and laboratory tests including complete blood count (CBC), serum iron, serum ferritin, TIBC (total iron-binding capacity), folic acid, T3, T4, TSH, fT3, fT4, female hormone profile (DHEAS, testosterone, androstenedione, prolactin, follicle-stimulating hormone, and luteinizing hormone). Laboratory tests were assessed to exclude other hair loss causes, such as anemia, poor nutrition, thyroid dysfunction, syphilis, or polycystic ovary syndrome. The extent and stage of FPHL were assessed according to the Ludwig classification.[9]

### 2.1 | Treatment protocol

Patients' scalps with pattern hair loss were randomly assigned (using the tossing coin method) to receive autologous PRP injection into a selected area, and another area was injected with normal saline as a placebo. The area of the scalp to be treated was cleaned with 70% alcohol. The injection technique was intradermal using an insulin syringe. Two days prior to the treatment, the patients were advised to wash hair with their regular shampoo. None of the patients received any other treatment for hair loss during PRP treatment. Four treatments were given for each patient, with an interval of 1 week between the sessions. Patients were followed up at 6 months after the last session.

For PRP preparation, 10 mL of fresh blood was collected from the median cubital vein under sterile conditions into a test tube prefilled with 1.5 mL of anticoagulant solution (sodium citrate). The tube was rotated in a centrifugation machine (centrifuge model 80-2A) at 1200 *g* for 15 minutes. The first centrifugation separated the blood into three layers, lowermost RBC layer, topmost acellular plasma layer called platelet poor plasma (PPP), and an intermediate PRP layer called the "buffy coat." Buffy coat with PPP was collected with the help of Finn pipette in another test tube. This tube was again centrifuged at 2000 *g* for 10 minutes. This allowed the platelets (PRP) to settle at the bottom of the tube. The upper layer containing PPP was discarded, and the lower layer of yielded PRP was collected in another clean tube. The platelet concentrate was loaded in 1-mL insulin syringes containing calcium gluconate in a 1:9 ratio (0.1 mL calcium gluconate per 0.9 mL of PRP) to induce platelet activation.

### 2.2 | Patient assessment

The effects of the treatment on hair growth, hair density (number of hairs/cm$^2$), hair diameter, and volume were assessed in all patients with the help of global photography, hair pull test, patient's satisfaction scale, and standardized phototrichograms. The evaluation of results was performed by an independent evaluator who was blinded regarding the treatment and control areas of the scalp and not involved in the administration of PRP treatment.

### 2.3 | Objective evaluation

Standardized high-resolution digital macrophotographs using identical camera settings (Cybershot, DSC-HX5V, Sony Corp, Tokyo, Japan) were obtained prior to PRP treatments and 6 months after the last session (7 months after starting therapy). The "hair pull test" was performed three times by the same clinician wherein a bundle of approximately 50-60 hair is grasped between the thumb, index, and middle finger from the base close to the scalp. The hair is firmly

tugged away from the scalp, and the extracted hair is counted in every session and at 6-month follow-up.

Phototrichograms of the patients were taken before treatment sessions and 6 months after the last treatment by a Folliscope (Model DLite, STR company, Felton, CA, USA) which is a digital computerized software with alopecia charts supported by a microviewer s/w. It measures hair density (number of hairs/cm$^2$) and hair thickness.

## 2.4 | Subjective evaluation

Patient satisfaction was graded on a linear analogue scale of 1-10 (1=no result, 10=best result) and recorded 6 months after the final session. Patients were also instructed to report any cutaneous side effects at each postoperative visit and at the 6-month follow-up.

**TABLE 1** Clinical data of the patients

| Characteristic | Value |
|---|---|
| Age,(mean±SD) | 29.3±6.56 |
| Ludwig classification, n (%) | |
| I | 13 (43.3) |
| II | 10 (33.3) |
| III | 7 (23.3) |

## 2.5 | Statistical analyses

Descriptive statistics was performed using mean±SD, median for metric and using proportions for categorical variables. The former was displayed using box plots while the latter through tables. Paired *t* test was used for analyzing metric variables satisfying the normality assumption. Wilcoxon signed rank test was used for ordinal variables (patient satisfaction) and metric variables not satisfying the normality assumption. Friedman's test was used to test significance of relationship between hair pull and time, instead of one-way ANOVA due to the presence of outliers, violation of normality assumption, and relative small sample size. All analyses were performed using IBM SPSS ver. 22 (IBM Corp., Armonk, NY, USA).

# 3 | RESULTS

Thirty female patients in the age group of 20-45 (mean 29.3±6.56) were included in the study. According to Ludwig classification of female pattern baldness, 13 patients were in grade 1, 10 patients were in grade 2, and seven patients were in grade 3 androgenetic alopecia (Table 1).

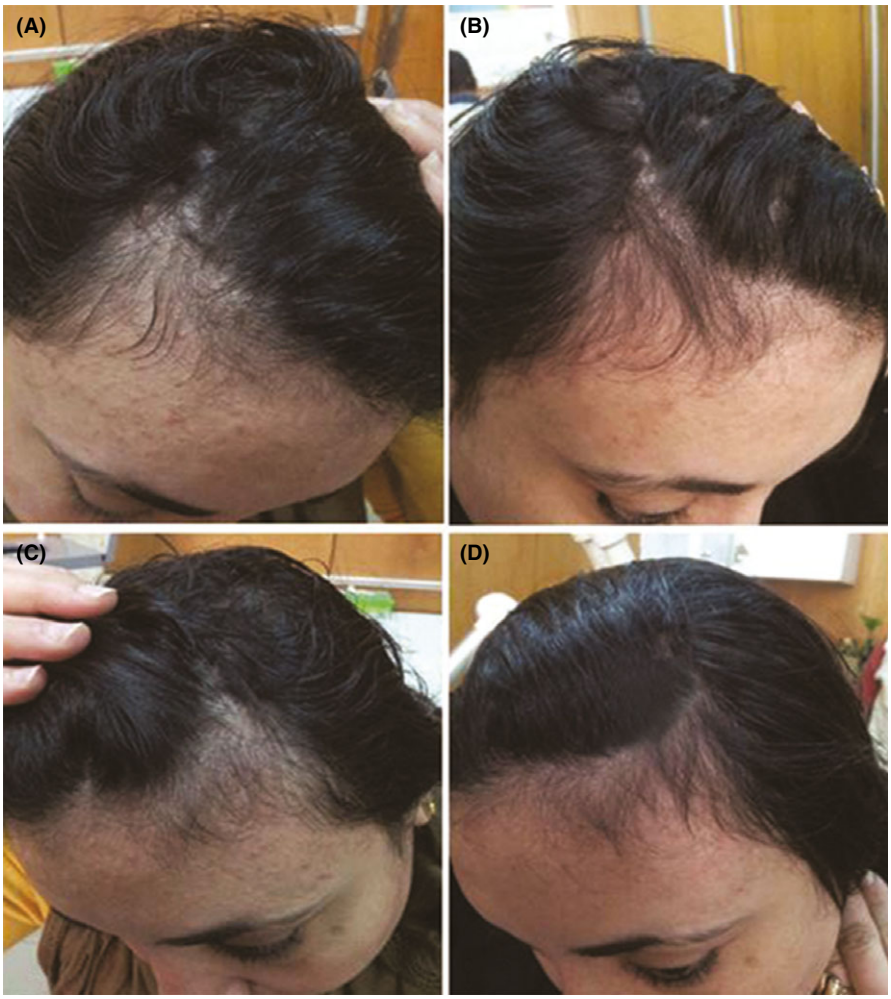


**FIGURE 1** A 27-year-old female patient with hair loss (A) at baseline,(B) clinical photograph 6 mo after four saline injections;(C) at baseline,(D) clinical photograph 6 mo after four Platelet-rich plasma (PRP) treatments

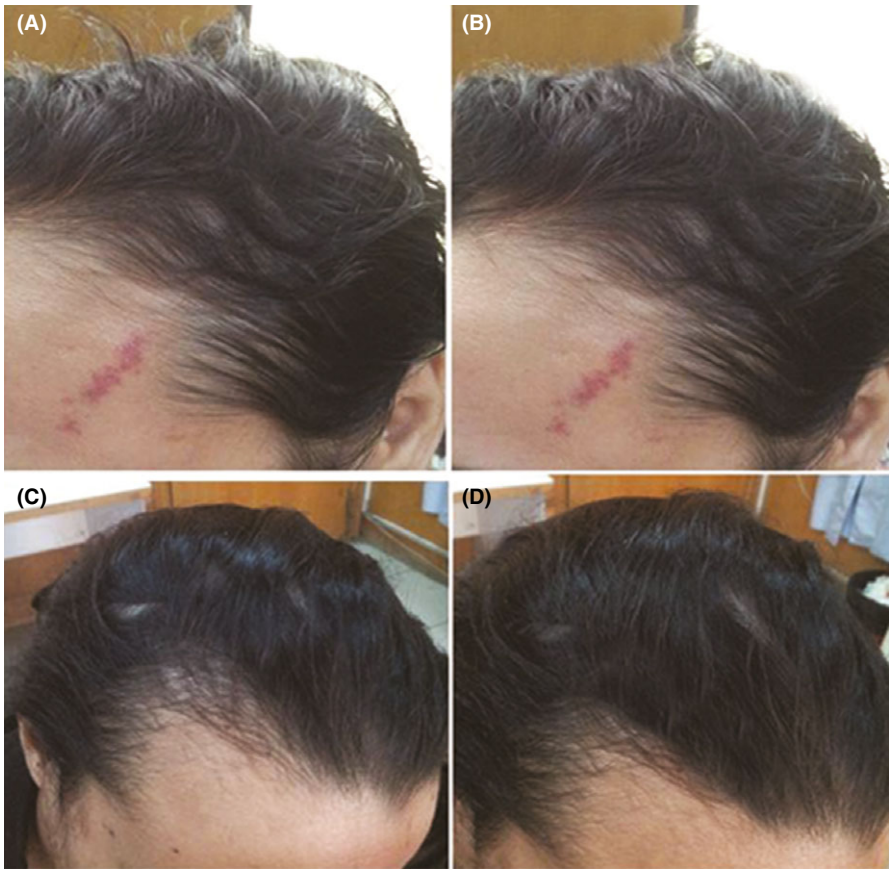


**FIGURE 2** A 36-year-old female patient with hair loss (A) at baseline,(B) clinical photograph 6 mo after four saline injections;(C) at baseline,(D) clinical photograph 6 mo after four Platelet-rich plasma (PRP) treatments

According to physician's assessment which was performed by comparing macroscopic photographs at baseline and 6 months after the last session, PRP-injected sites showed an overall improvement in hair density and thickness, as lanugo-like hair became thicker, normal hair. Moreover, a significant reduction in hair loss was observed between first and fourth PRP injection as noticed by patients (Figure 1-3).

Before treatment, all the patients (100%) had a positive hair pull test with a mean number of 10 hairs in both PRP-injected areas and placebo areas. At the 6-month follow-up, the pull test was negative in PRP-injected areas in 25 patients (83%) with average number of three hairs, whereas in placebo areas, the hair pull test remained positive with a mean number of eight hairs (Figure 4).

The various hair growth parameters (hair thickness and hair density) measured by the folliscope after 6 months of the last treatment in both PRP and placebo areas were compared with the baseline study before treatment and between both PRP and placebo areas (Table 2; Figures 5 and 6).

At 6-month follow-up, areas treated with PRP yielded a significant increase in both hair density and hair thickness in comparison with baseline ($P<.005$).On the other hand, in placebo-injected sites, there was a mild increase in hair density ($P=.06$) and hair thickness ($P=.09$) at 6-month follow-up compared to baseline. However, this increase was not significant.

Accordingly, in PRP area, a mean increase in hair density of 77.28 (number of hairs/cm$^2$) was observed after 6 months, and the placebo area displayed a mean increase of 17.81 in hair density at the same time. In addition, hair thickness improved significantly by 0.11 mm in PRP area compared to baseline, while increasing by 0.03 mm in the placebo area of the scalp.

At baseline, there were no statistical significant differences in hair density, and hair thickness between PRP and placebo areas of the scalp ($P=.3$). Meanwhile, at 6-month follow- up, there was a statistical significant difference between PRP and placebo areas ($P<.005$) regarding both hair density and hair thickness.

In PRP-injected sites, there was a high overall patient satisfaction with a mean result rating of 7.0 on a scale of 1-10. They experienced only temporary pain and pinpoint bleeding at the injection sites, and these symptoms disappeared within a day. No major side effects were reported during treatment.

## 4 | DISCUSSION

Female pattern hair loss is solely a cosmetic concern which fosters psychological distress for patients, as it has a notable impact on quality of life; thus, women seeking evaluation want successful treatments that can minimize further hair loss while also stimulating new hair growth or regrowth of previously lost hairs.[10]

The current study could be added to recent research welcoming the relative newcomer PRP to the dermatologic field. It provides further evidence of the potential benefits that the use of PRP offers as an alternative treatment modality in FPHL.

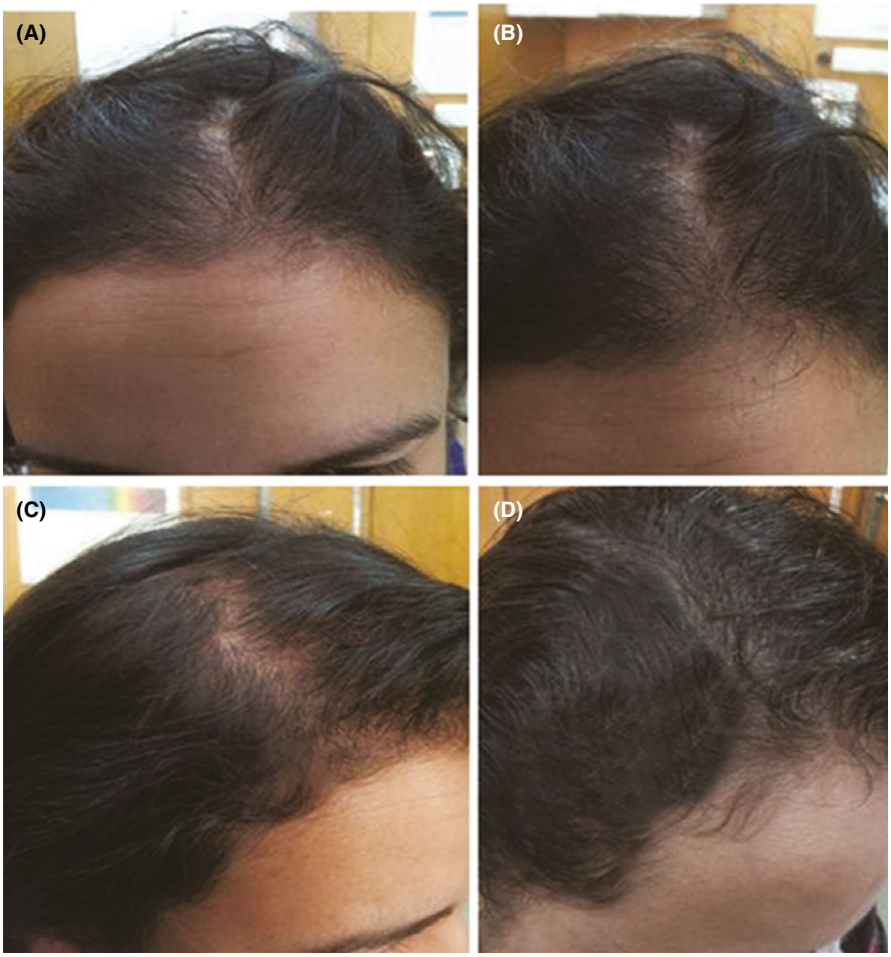


**FIGURE 3** A 38-year-old female patient with hair loss (A) at baseline,(B) clinical photograph 6 mo after four saline injections;(C) at baseline,(D) clinical photograph 6 mo after four Platelet-rich plasma (PRP) treatments

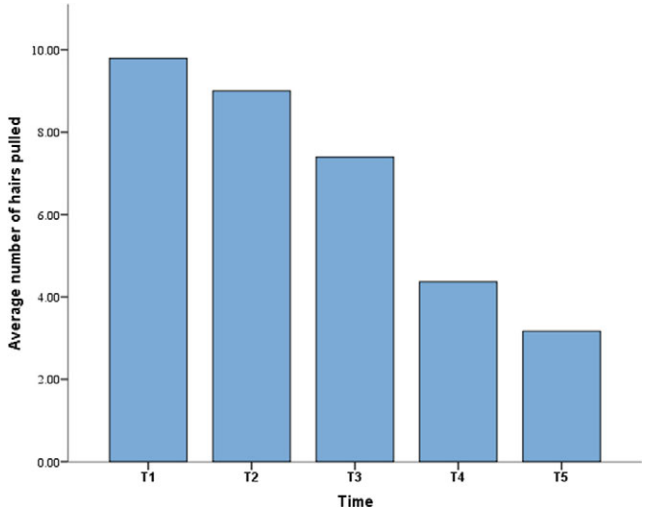


**FIGURE 4** Average number of hairs pulled during hair pull test at T1(baseline), T2(second Platelet-rich plasma (PRP) session), T3 (third PRP session), T4(fourth Platelet-rich plasma (PRP) session), T5(6-mo follow-up)

In the current study at the 6-month follow-up, global photographs and folliscope photographs showed significant improvement in both hair density and hair thickness in all patients treated with PRP compared to baseline. This was confirmed by a high overall patient satisfaction in the absence of major side effects. Additionally, there was a statistical significant difference between PRP and placebo areas ($P<.005$) regarding both hair density and hair thickness at 6-month follow- up.

In the present study, at baseline, all the patients (100%) had a positive hair pull test with a mean number of 10 hairs in both PRP-injected areas and placebo areas. At the 6-month follow-up, the pull test was negative in PRP-injected areas in 25 patients (83%) with average number of three hairs. While in placebo areas, the hair pull test remained positive with a mean number of eight hairs. This finding was comparable to that of Besti et al.[11]

Our PRP results were supported by what Gentile et al.[12] has found. They conducted a randomized, placebo-controlled, half-head group study to compare the hair regrowth with PRP versus placebo. At the end of the three treatment cycles, the patients presented clinical improvement in the mean number of hairs, with a mean increase of 33.6 hairs in the target area and a mean increase in total hair density of 45.9 hairs per $cm^2$ compared with baseline values. No side effects were noted during treatment.

Similarly, Gkini et al.[13] injected PRP in 20 patients, males and females, with AGA. Three months after the first treatment, a significant increase in hair density was noted ($170.70\pm37.81$, $P<.001$). At 6 months and at 1 year, hair density was also significantly increased, $156.25\pm37.75$ ($P<.001$) and $153.70\pm39.92$ ($P<.001$) respectively,

**TABLE 2** Relevant hair growth parameters assessed by folliscope analysis for the treatment and placebo areas at baseline and at 3-mo follow-up

| | Hair density | | Hair thickness | |
|---|---|---|---|---|
| | Placebo | PRP(platelet-rich plasma) | Placebo | PRP |
| At baseline (mean±SD) | 73.25±9.98 | 73.66±9.42 | 0.1±0.03 | 0.1±0.03 |
| At 6-month follow-up (mean±SD) | 91.06±9.71 | 150.94±19.17 | 0.13±0.03 | 0.21±0.04 |

comparing to that of baseline. Nevertheless, it was lower than that of 3 months. Patients were satisfied with a mean result rating of 7.1 on a scale of 1-10 without noting any remarkable adverse effects.

The action of platelet plasma growth factors on the hair cycle has already been established. In 2006, Uebel et al.[8] observed a significant improvement in hair density and stimulation of growth when follicular units were pretreated with platelet plasma growth factors before their implantation. There was a significant difference in the yield of follicular units on comparing the experimental with the control areas of the scalp.

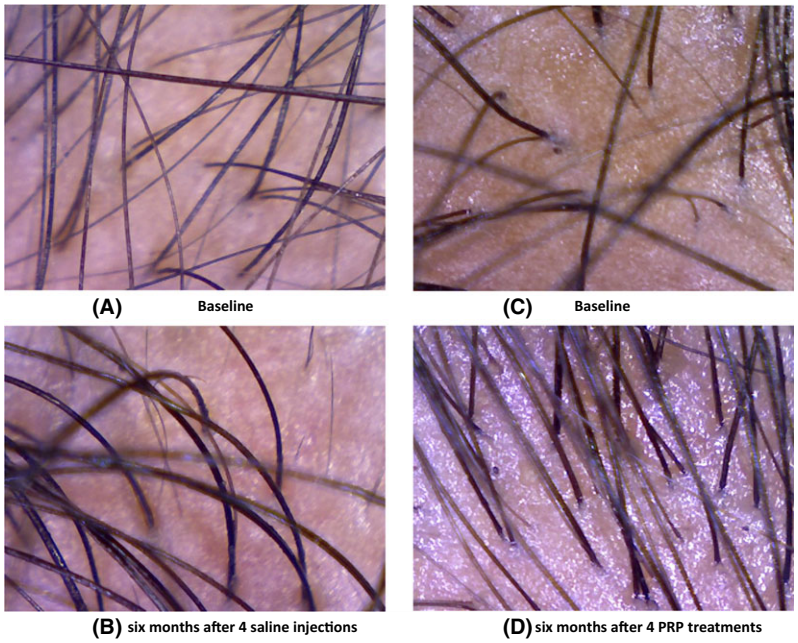


**FIGURE 5** Phototrichograms of female pattern hair loss (A) at baseline, (B) 6 mo after four saline injections; (C) at baseline, (D) 6 mo after four Platelet-rich plasma (PRP) treatments(×10 magnification)

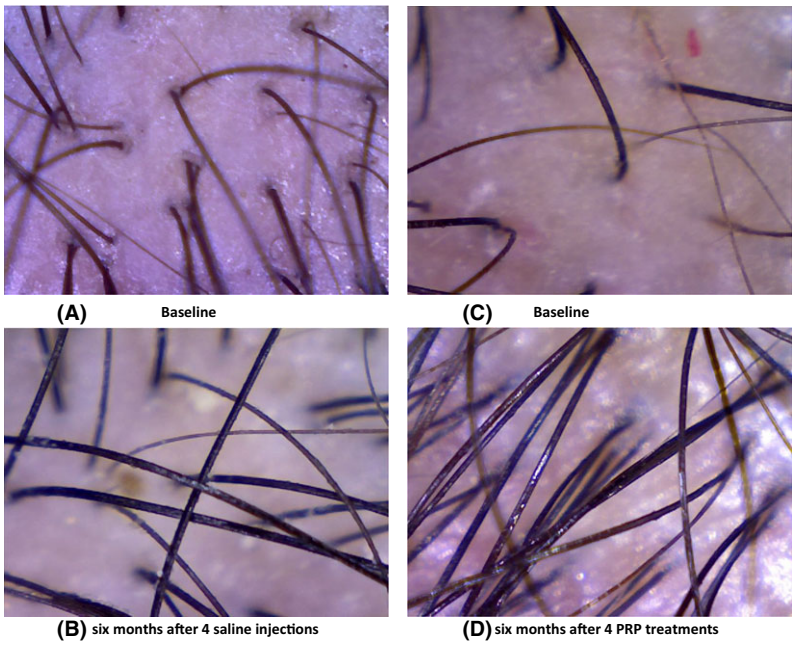


**FIGURE 6** Phototrichograms of female pattern hair loss (A) at baseline, (B) 6 mo after four saline injections; (C) at baseline, (D) 6 mo after four Platelet-rich plasma (PRP) treatments(×10 magnification)

The growth factors contained in platelets of blood plasma include platelet-derived growth factor (PDGF), transforming growth factor-β, vascular endothelial growth factor (VEGF), epidermal growth factor, and connective tissue growth factor (FGF). When platelets become activated, these growth factors are released and promote differentiation of stem cells into hair follicle cells through the upregulation of transcriptional activity of β-catenin.[14,15]

Activated PRP also induces in vitro proliferation of dermal papilla cells and increases dermal papilla cell growth by activating (ERK) signaling. In addition, PRP appears to prolong anagen phase of hair growth cycle through increased expression of FGF-7 and to increase cell survival by inhibiting apoptosis (associated with increased Bcl-2 protein levels as well as activated Akt signaling). It also appears to increase the perifollicular vascular plexus, through the increase in VEGF and PDGF levels, which have an angiogenic potential.[6]

Worthy to be noted in the present study, there was a mild increase in both hair density and hair thickness in placebo-injected areas at the 6-month follow-up. Nevertheless, this increase was not significant. Moreover, the hair pull test decreased from a mean number of 10 hairs at baseline to eight hairs at the 6-month follow-up. This improvement could be attributed to the fact that microneedling stimulates the release of various growth factors, through platelet activation and skin wound regeneration mechanism. In addition, microneedling induces activation of stem cells in the hair bulge area under wound healing conditions and enhances the expression of hair growth-related genes.[16–18]

## 5 | CONCLUSION

We can assume that PRP injection for FPHL is a simple, cost-effective, and feasible treatment option with excellent safety profile. However, further randomized, controlled, double-blind studies with approved devices for PRP preparation, details in PRP preparation and application, with larger sample size, longer follow-up, and objective evaluation methods are needed to assess the efficacy and safety of PRP. The questions are whether PRP will mimic the efficacy of existing treatment options, such as minoxidil, and whether it could be used as a standalone therapy or as an adjuvant therapy with other treatment modalities. Nevertheless, PRP can be considered an alternative therapeutic modality for women of childbearing age, who cannot take oral medication such as finasteride, and for patients with adverse effects and or refractory to finasteride or minoxidil.

### CONFLICT OF INTEREST

None declared.

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