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Injectable platelet-rich fibrin for treatment of female pattern hair loss

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ABSTRACT

This case series evaluated use of injectable platelet rich fibrin (termed i-PRF+) for the treatment of female pattern hair loss (FPHL). Eleven individuals underwent 3-monthly intradermal injections of i-PRF+ using a mesotherapy gun. The mean number of hair follicles containing hairs per unit area improved at 3- and 6-months follow-up ($p < .001$), and all participants had a negative hair pull test. Hair volume and thickness, and patient-reported outcome scores also improved at follow-up ($p < .001$). Adverse effects were minor and self-limited. A series of three i-PRF+ injection sessions were effective for the treatment of FPHL, as shown by improved hair analysis parameters and patient self-assessment scores.

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Androgenic alopecia; female pattern hair loss; mesotherapy; PRF; platelet

Introduction

Female androgenic alopecia (AGA), also known as female pattern hair loss (FPHL), is the most common hair loss disorder in adults affecting 40% of women by 70 years of age (1,2). FPHL is a common form of non-scarring hair loss that primarily occurs in adult life. It is typically characterized by progressive loss of terminal hairs over the frontal and crown regions of the scalp, resulting in a visible reduction in hair density. Unlike many cases of male AGA (male pattern hair loss), the loss of terminal hairs in affected areas is usually incomplete and the frontal hairline is often spared. FPHL often presents as either diffuse central thinning with preservation of the frontal hair line in a "Christmas tree-like pattern," or with bilateral recession of the hairline in the temporal regions (3).

While there is no definitive cure for this benign disorder (4), the demand for hair regrowth and restoration is high due to the associated psychological impact of this perennial issue (5). Hair is often associated with youth, beauty, and health. For females, hair often portrays sexual attractiveness, femininity, and self-confidence (3,6). Although FPHL is a benign disorder, hair loss, even though negligible, can have a profound impact on patient's self-image, self-esteem and overall QoL (3,7).

Topical minoxidil (2% and 5% concentrations) is the only drug treatment approved by the Food and Drug Administration for FPHL (8). Additional treatments include oral spironolactone, oral and topical finasteride, low-level laser therapy, and hair transplantation (3,8). The results are variable, with associated costs, side effects and risks of these treatments an obstacle for many patients. In the past decade, autologous platelet aggregates (APAs) have been proposed as a potential therapy to treat FPHL, either alone or in combination treatment (9–11). APAs contain supra-physiological quantities of platelets and autologous growth factors important for cell migration, cell proliferation, and collagen deposition. APAs are believed to stimulate hair growth by promoting vascularization, angiogenesis, and extension of the anagen phase by growth factor-mediated activation of Wnt/β-catenin, extracellular signal-regulated kinase (ERK), and Akt signaling pathways which induce cellular proliferation and differentiation in the bulge area of the hair follicle (12,13). Platelet-rich plasma (PRP) injections have been used as a treatment for hair loss, including a small number of studies evaluating its use in FPHL (7).

More recently, a second-generation APA, known as platelet rich fibrin (PRF), has been developed. Unlike PRP, PRF is obtained using a one-step centrifugation process without the use of anticoagulants and is thereby totally autologous. The resulting product contains cell types (platelets, leukocytes, macrophages, red cells), an extracellular fibrin matrix, and an array of bioactive molecules (predominately growth factors). Depending on the blood collection tube and centrifugation protocol, PRF can be produced in solid gel or liquid forms. Solid gel PRF, created using glass tubes, is suitable for applications like bone grafting in dental implants and fat grafting, with proven benefits in oral, maxillofacial, and plastic surgery for tissue regeneration and infection control (14–16). Injectable PRF (known as i-PRF) was developed in 2014 (14,17) using lower centrifugation speeds (700 rpm instead of 1300 rpm) and times (reduced from 8 to 3 min), along with plastic tubes with a textured hydrophobic surface to prevent clot formation (18). The lower centrifugation speed (relative centrifugal force [RCF] ~60 g) results in a higher number of platelets, leukocytes, and growth factors (19). The plastic tubes allow the PRF to remain in a liquid form for around 20 minutes post-collection, facilitating injection into the skin or scalp. Once injected, the liquid fibrinogen and thrombin are converted to a more solid fibrin matrix that gradually releases growth factors over weeks, offering

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sustained benefits compared with the rapid release of bioactive molecules seen with PRP (14,20).

In 2018, further advancements led to the development of second-generation PRF, known as i-PRF plus (+) (21). This refined process involves using a larger plastic tube (13 vs 10 mL) and slightly longer centrifugation time (5 min at 700 rpm), resulting in increased volume and concentration of platelets, white cells, and mesenchymal stem cells in i-PRF+ (21). These enhancements optimize the regenerative potential of the PRF product for improved treatment outcomes.

Several studies have documented the use of i-PRF for oral and maxillofacial procedures (15,22,23) and facial rejuvenation (21). In addition, two small case series have reported use of injectable PRF for male pattern alopecia (24,25). To date, no studies have reported the use of injectable PRF for the treatment of FPHL.

This study evaluated the objective and subjective effects of administration of i-PRF+ for the treatment of FPHL.

Methods

Study design and participants

This was a single-center, uncontrolled, prospective case series of female adults (April to November 2021) seeking treatment with PRF scalp injections for FPHL. The study was conducted following local ethics committee approval (Queen Mary University of London) and written informed consent (for treatment procedures and photography) from all participants. The diagnosis of FPHL was based on clinical manifestation (Ludwig hair loss classification) and scalp digital microscopy.

Eligible participants were healthy females aged >18 years with no history of prior surgical or any medical/treatment interventions for FPHL. All participants underwent a combination of clinical assessment and blood tests prior to enrollment to exclude secondary causes of hair loss, such as thyroid function, anemia, and polycystic ovary syndrome. Participants agreed to abstain from any medications, aesthetic interventions (energy-based treatments), hair transplantation, or topical hair cosmeceuticals during the study duration.

Procedures

The study was conducted over a 26-week period at an aesthetic clinic during which the participants attended the clinic on six occasions (Figure 1). During the baseline visit, a detailed participant social and contemporaneous medical history was taken. A clinical examination and hair pull test (see details below) was conducted. Detailed information about the study, expected results and protocol was provided. All participants then underwent digital microscopy (Digital Jiusion 40-1000× microscope, RoHS, FC, CE, China), and standardized high-resolution digital photography in the frontal, temporal and vertex regions using identical camera settings (LUMIXDMC-GX8 mirrorless camera with 20 mm lens, Panasonic, Japan). The validated Women's Androgenetic Alopecia Quality of Life Questionnaire (WAA-QoL) (26) was administered by an assistant not involved in the study. Participants recorded any adverse effects after the treatment procedure in a post-treatment diary. Pre- and post-treatment instructions were provided.

Participants received 3 successive treatments sessions of i-PRF+ in specific regions of the scalp associated with hair loss. The initial treatment was performed 2 weeks after the baseline visit (visit II). Two further treatments (each 4 weeks apart) were performed in week 4 (visit III) and week 8 (visit IV).

At week 12 (visit V, 3 months following initial treatment and 1 month following the third and final treatment) clinical objective and subjective evaluations were repeated. Digital microscope imaging of the same scalp location as baseline (using the anatomical landmark and scalp grid described below) was performed and 2D clinical photographs were taken. Participants completed the WAA-QoL questionnaires.

The same clinical objective and subjective evaluations were repeated at week 24 post-baseline (visit VI, 6 months following initial treatment and 4 months following the third and final treatment).

During each clinic visit, the previous treatment was discussed, and any adverse events were reported. All participants were encouraged to record any such event and/or adverse effects in a post-treatment diary. Post-treatment diaries were collected from all participants at week 12 (visit V).

i-PRF+ preparation

Under aseptic conditions, 26 mL of venous blood was collected in two 13 mL sterile plastic i-PRF+ tubes (i-PRF+, Process for PRF™, Nice, France) (Figure 2a), without anticoagulant and centrifuged immediately (Duo Quattro Centrifuge, Process for

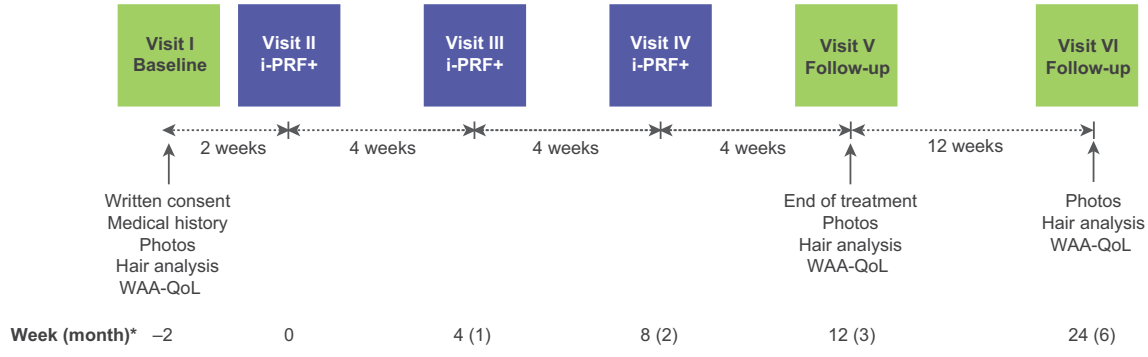

Figure 1. Study design. *Indicates month following initial treatment session

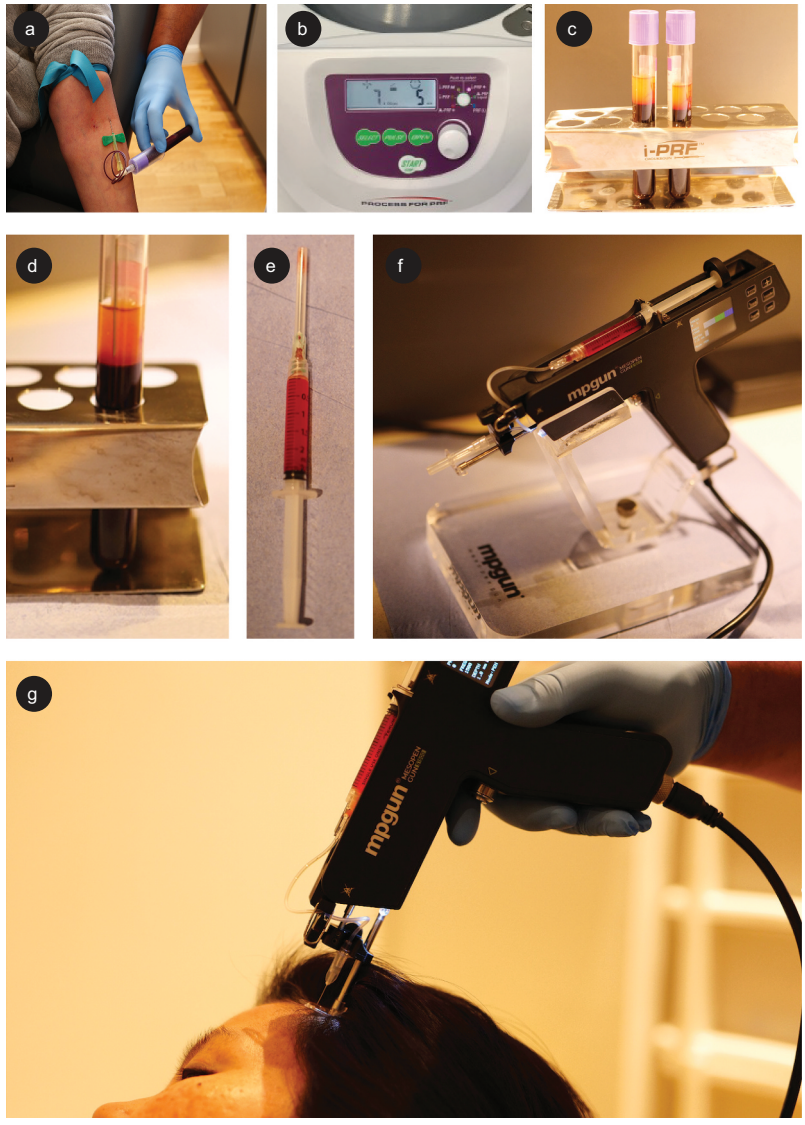

Figure 2. Preparation and administration of injectable platelet-rich fibrin plus (i-PRF+) (**a**) venipuncture and blood sample collected in 13 mL plastic tube (**b**) centrifuge for 5 min at 700 rpm (**c**) separation of blood and plasma following centrifuge (**d**) extraction of top plasma layer using an 18 G needle (**e**) i-PRF+ collected in a 2 mL syringe (**f**) 3 mL syringe connected to injection tube and 27 gauge needle ready to be injected (**g**) scalp injections of i-PRF+ using the mpgun.

PRF, Nice, France) at room temperature using the recommended low RCF i-PRF+ protocol (700 rpm for 5 min, 60.3 g RCF) (Figure 2b), as described previously (21). The drawn blood is now separated into two layers with the upper layer containing the separated plasma and platelets (Figure 2c). The upper (yellow-orange color) 2 mL of the supernatant layer was removed using an 18-gauge 1.5-inch BD^{TM} blunt fill needle (Becton Dickinson, Fraga, Spain) (Figure 2d) into a 2 mL sterile BD Luer-Lok^{TM} Tip syringe (Becton Dickinson, Franklin Lakes, NJ, USA) (Figure 2e). The 2 mL syringe containing i-PRF+ was then mounted within the mesotherapy device (mpgun®, Biopark Medical, Istanbul, Turkey) (Figure 2f).

i-PRF+ treatment

To ensure reproducibility and to minimize bias, a standardized injection guide (scalp grid) was used for each participant (Figure 3). The scalp grid was constructed using clean unwaxed dental tape (60 cm in length, Oral B, Satin Tape, Gillette, USA) that was marked at 1 cm intervals with a black marker pen and then moved at standardized intervals from an imaginary midpoint line.

The initial primary injection points were elucidated by placing the dental floss along an imaginary midpoint line (AB line in Figure 3) extending from a point midway between the pupils (Point A) and extending posteriorly to the midpoint of the occipital protuberance (Point B). The 1 cm intervals marked by the dental floss, within the hair bearing regions of the scalp, denoted the initial primary injection points. Subsequent secondary injection points were established by moving the gradated dental tape laterally by 1 cm, parallel to the original AB line and then again by another 1 cm until all treatment areas were performed.

The scalp was cleansed using sterile gauze and a nonalcoholic cleanser (Clinisept+; Clinical Health Technologies, UK). Intradermal i-PRF+ injections perpendicular to the scalp were performed in the scalp grid using

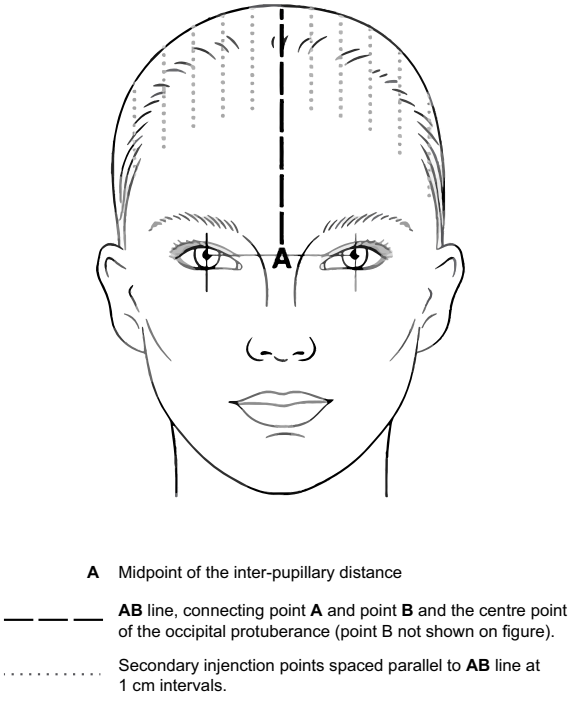

Figure 3. Standardized injection guide (scalp grid) used in the study. The small dots represent the sites of injection at 1 cm intervals.

the mesotherapy device and its accompanying sterile needle and catheter set containing a 27-gauge needle (Figure 2g). In total, ~4 mL of i-PRF+ (~2 mL for each half of the scalp) was administered to each participant during each treatment session using the same settings on the mesotherapy device (gun mode, injection depth 1.5–2.5 mm, 25% pressure, 1 cm separation). Each treatment session was completed within 15 minutes after preparation of the i-PRF+ to ensure patency of the product.

After completion of the intradermal injections, any remaining i-PRF+ was applied topically and massaged into the scalp. Post-procedure advice regarding swelling, bruising and pain was provided to each participant. Participants were advised to avoid washing their hair for 8 hours following each treatment, avoid dust and sun exposure, hair gel and cream, hair coloring, hair straightening/braiding, to restrict strenuous activities, and avoid anti-inflammatory drugs for the next 10 days. Emergency contact mobile numbers were provided to each participant.

Objective evaluation

The effects of the i-PRF+ treatment on hair growth were assessed by several hair analysis techniques. First, the number of hair follicles containing hair per unit area (mm^2) (or hair density) was assessed with digital microscopy. The 1 cm grid scale (described above) was used to calculate the area (mm^2) and the number of follicles with hair contained within the microscopy image was calculated. Second, a hair pull test was used to assess the mean number of hairs shed. Third, visual assessment of the hair diameter and hair thickness were assessed by digital microscopy and by standard clinical photography.

The "hair pull test" was performed three times by the same individual (SS) at baseline and weeks 12 and 24 (3 and 6 months following initial treatment, respectively) whereby ~ 50–60 hairs were grasped between the thumb, index, and middle finger at the base close to the scalp. The hairs were firmly tugged away from the scalp from three separate sites. The number of hairs pulled was counted and a mean value for the three sites was recorded. A positive hair pull test was defined as > 10% or ~ 6 hairs shed during the test indicating active hair shedding (27). If fewer than 10% were removed, then the hair loss is usually attributed to normal physiological shedding.

Standard clinical photos of the participants' scalps were taken at baseline and at week 12 (visit V, 3 months following initial treatment) and week 24 (visit VI, 6 months following initial treatment) so that comparisons of appearance could be made. Three independent assessors with no participation in the study evaluated the hair diameter and hair thickness in the digital and clinical photographs.

Subjective evaluation

The validated WAA-QoL patient-reported outcome measure, a health-related (HR) QoL measure specific to female hair loss (26), was used to measure the impact of FPHL and the impact of treatment with i-PRF+ on the quality-of-life of the enrolled participants.

The WAA-QoL is a 16 item self-report measure of HRQoL in women with AGA. Respondents were required to indicate the degree to which the experiences described in the items had happened to them in the past week (28). Responses were recorded on a seven-point Likert scale ranging from 0 = "not at all" to 6 = "extremely." Raw scores for responses to the 16 questions were combined to provide a total score ranging from 0 (high HRQoL) to 96 (low HRQoL).

Statistical analysis

Quantitative continuous variables for the digital microscopy, hair pull test and WAA-QoL results were summarized as descriptive statistics (mean ± standard deviation [SD]). The mean difference from baseline to 12- and 24-week follow-up for each individual (or each WAA-QoL question) was calculated. Student's t-test (one-sample, paired) was used to compare continuous variables within the same participant at baseline and at follow-up. Statistical analysis was performed using SPSS v19.0.0.1 (IBM, Armonk, NY). Statistical significance was accepted when p-values were < 0.05. Relative percentage change in the values of variables/parameters was used to evaluate the potential improvement at different follow-up windows.

Results

Eleven healthy female individuals with FPHL, mean age of 45.1 ± 12.6 years (range 32–74) were included in the study. The mean duration of hair loss was 37 months (range 4–72 months). Fitzpatrick skin types ranged from I to IV. Ludwig hair loss scale ranged from I to II, with II being the most common.

Objective assessments

Digital microscopy analysis

On digital microscopy, the mean number of follicles containing hair at baseline per unit area (mm^2) was 0.57 ± 0.20. Following i-PRF+ treatment, there was a significant increase in the number of follicles containing hair per mm^2 at 12- and 24-week follow-up (0.89 ± 0.29 [$p = .007$] and 1.03 ± 0.24 [$p < .001$], respectively) (Figure 4a).

An increase in the number of follicles containing hair was seen in all participants (data not shown). At week 12, the percentage increase from baseline in hair follicles containing hair per mm^2 in individual participants ranged from 34% to 132%, with an overall mean increase of 62%. At week 24, the percentage increase from baseline in hair follicles containing hair per mm^2 ranged from 50% to 268% with a mean overall increase of 97%. Each of the three independent assessors reported that there was a perceived

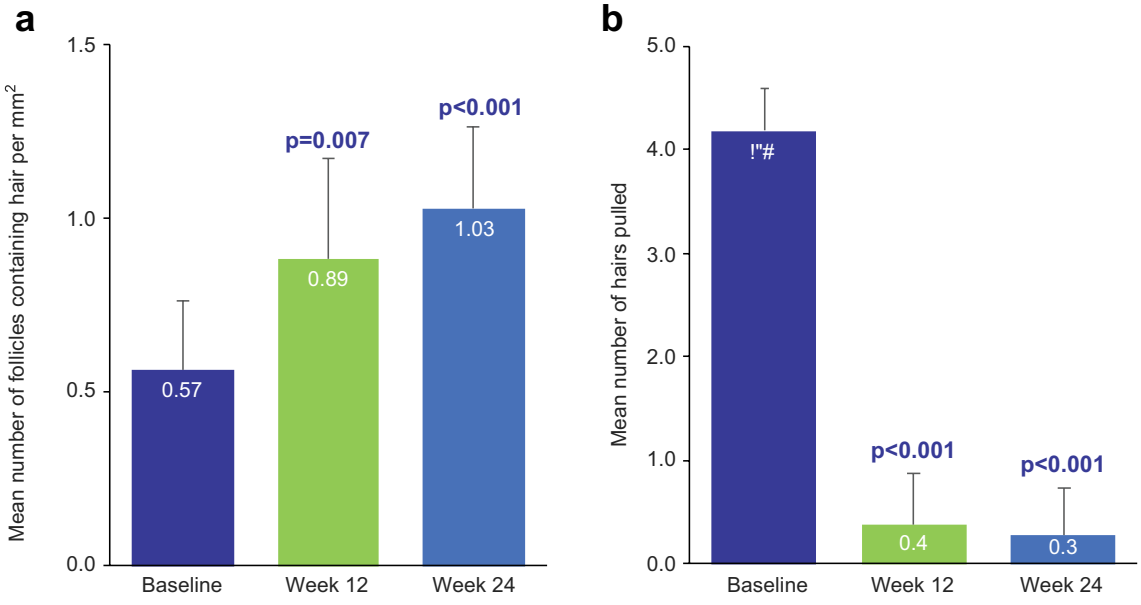

Figure 4. Mean (±SD) number of hair follicles containing hair per mm^2 on digital microscopy (**a**) and mean (±SD) number of hairs pulled during hair pull tests (**b**) at baseline, and at weeks 12 and 24 following treatment with i-PRF+. In A, $p = .004$ for week 12 versus 24. In B, $p = .59$ for week 12 versus 24.

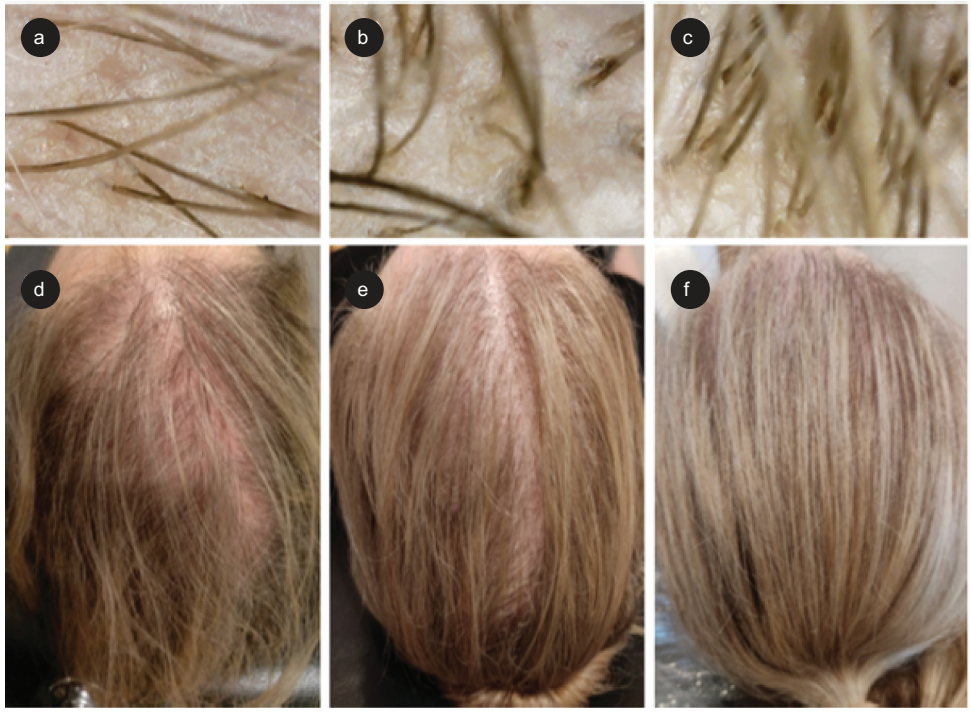

Figure 5. FPHL in a 40-year-old female with woman with grade II Ludwig's scale hair loss. Dermatoscope images at baseline (**a**), 1 month after 3 treatment sessions of i-PRF+ (week 12. **b**) and 4 months post i-PRF+ treatment (week 24, **c**). The corresponding clinical photographs of the same participant are shown at baseline (**d**), week 12 (**e**) and week 24 (**f**) highlighting the increased hair density after 12 weeks of i-PRF+ treatment.

increase in hair diameter following treatments with i-PRF+ compared with baseline (data not shown).

Hair pull tests

Before treatment, two participants had a positive hair pull test (i.e.,>10% of hairs shed in the sample pulled). The mean number of hairs pulled among the 11 participants at baseline was 4.2 ± 0.4 (Figure 4b). Following i-PRF+ treatment, none of the participants had a positive hair pull test at weeks 12 and 24. The mean number of hairs pulled across all participants decreased to 0.4 ± 0.5 and 0.3 ± 0.5, respectively ($p < .001$ versus baseline) (Figure 4b).

Clinical photography

Independent assessment based on comparing macroscopic photographs at baseline and follow-up, showed a clinically relevant improvement in perceived visual hair thickness and fullness in all participants with a reduction in visibility of the scalp devoid of hair (Figure 5). In one participant, there was a notable change in the color of the treated hairs, appearing darker than before treatment.

Subjective assessment

All participants completed the WAA-QoL questionnaires at baseline and at the two follow-up visits. Similarly, the post-treatment diary was completed by all participants following each of the 3 treatment sessions.

Based on the treatment diaries and verbal feedback during the clinic visits, all participants were satisfied with the thickness and appearance of their hair following the 3 treatment sessions. They reported new hair growth ~ 6–8 weeks after the first treatment session, especially in areas that they had not felt it before or in areas previously devoid of hair. Several participants reported a noticeable reduction in hair loss within the first 3–4 weeks after the initial treatment. One participant reported a notable change in the color of the treated hairs, stating that it appeared darker than before treatment.

WAA-QoL

At 12 and 24-weeks follow-up, the total response scores for the 16 WAA-QoL questions reduced from mean value of 78.8 ± 8.7 at baseline to 29.9 ± 10.5 at week 12 and 11.7 ± 8.3 at week 24 ($p < .001$ for both) (Table 1A).

Each of the 16 WAA-QoL questions showed a significant improvement at the 12 and 24-week follow-up visits (Table 1B). The questions assessed the impact on the perception of continued hair loss, scalp visibility, hair styling and emotional aspects including jealousy and feeling unattractive. At week 12, the mean decrease in concerns relating to scalp visibility and continued hair loss was 79% and 64% versus baseline, respectively ($p < .001$ for both). At week 24, the mean decrease in the same concerns was 95% and 95% versus baseline, respectively ($p < .001$). Significant improvements in the emotional aspect were observed with a mean decrease of 80% in feelings of jealousy and

Table 1. Total responses score to the 16 item self-reported WAA-QoL questions for each participant (**a**), and each individual question (**b**) at baseline and at weeks 12 and 24 following i-PRF+ treatments. For each question, participants choose from the following alternatives: 0 = not at all, 1 = a little bit, 2 = somewhat, 3 = a good bit, 4 = quite a bit, 5 = very much, 6 = extremely.

	Participant number											
	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	Mean ± SD
Baseline	94	83	83	68	89	77	69	69	76	74	85	78.8 ± 8.7
Week 12	46*	34*	33*	16*	37*	37*	13*	17*	29*	25*	40*	29.9 ± 10.5*
Week 24	22*	13*	17*	3*	16*	19*	4*	2*	4*	5*	24*	11.7 ± 8.3*

Total response score to the 16 questions for each participant ranged from 0 (high HRQoL) to 96 (low HRQoL). *$p < .001$ versus baseline.

B

Question	Baseline ($N = 11$)	Week 12 ($N = 11$)	Week 24 ($N = 11$)
1. Feeling self-conscious about people looking at hair	63	29*	10*†
2. Jealous of others who have lots of hair	62	22*	9*†
3. Negative impact of hair on self-confidence	63	19*	6*†
4. Feeling unattractive because of problems with hair	43	10*	7*§
5. Uncomfortable socializing because of problems with hair	53	24*	10*†
6. Uncomfortable socializing with same or opposite sex	55	22*	11*†
7. Negative impact on satisfaction with appearance of hair	43	26*	12*†
8. Negative impact on hair styling	46	15*	8*§
9. Feeling powerless to do anything about hair problems	46	8*	3*‡
10. Feeling embarrassed because of appearance of hair	62	22*	10*†
11. Feeling frustratedbecause of problems with hair	44	27*	9*†
12. Concerns about hair parting and showing scalp	57	12*	3*†
13. Concerns about continued hair loss	56	20*	3*†
14. Time spent on hair styling to make hair look fuller	64	20*	12*‡
15. Feeling annoyed about having to spend time fixing hair	57	23*	8*
16. Checking hair in mirror because of hair problems	52	30*	8*

N= total number of participants completing each question. The maximum value for response to each question (range 0 to 6) for the 11 participants is 66. *$p < .001$ versus baseline. †$p < .001$ for week 12 versus week 24. ‡$p < .05$ for week 12 versus week 24. §$p > .05$ for week 12 versus week 24.

unattractiveness at week 24 ($p < .001$). Similar decreases in problems with hair affecting self-confidence were reported at both follow-up visits.

Safety assessment

All participants experienced occasional sharp pain during the i-PRF+ injections that lasted for a few seconds. This discomfort was described as average or below average but deemed tolerable. Two participants experienced headache and/or soreness following treatment that lasted for a few days. Other minor and transient adverse effects following i-PRF+ treatment included mild transient headache, mild bruising and swelling, all of which resolved within 2–4 days.

Discussion

This prospective study evaluated objective and subjective outcomes following three monthly sessions of intradermal injections of i-PRF+ using a mesotherapy device to individuals with FPHL. The efficacy of the treatment was assessed by objective digital microscopy and a hair pull test which was supplemented by a subjective patient-reported outcome (WAA-QoL) assessment at baseline at weeks 12 and 24. Significant improvements in the hair microscopy parameters were mirrored by perceived visual clinical improvement in hair follicles containing hair(s) and hair thickness. Subjective analysis supported the objective analysis with all participants perceiving a significant improvement in several hair parameters. The protocol used to administer i-PRF+ was well tolerated and the adverse effects were transient and minimal. Taken together, these findings suggest a benefit for the use of i-PRF+ for treatment of FPHL.

The efficacy assessments in this study included digital microscopy, a hair pull test and clinical photography. Microscopy assessment of hair density was based on the number of hair follicles containing hair per mm^2. This endpoint assessed if there was a change in the number of follicles containing new hair(s), thereby providing a preliminary assessment of hair regrowth. We recognize that this assessment of hair density differs slightly from other studies that define hair density as the total numbers of hairs per cm^2 (10,29,30). Visual assessment of the microscopy images by the independent assessors evaluated if there were any changes in the thickness (diameter) of individual hair follicles following treatment. The microscopy assessment was supported by a hair pull test that remains widely used in hair studies.

The microscopy evaluation and hair pull tests used in our study remain relatively time consuming to perform. To shorten this process and provide more objective analysis of the effect of treatment on hair follicles, automated digital image analyzers have recently been developed and successfully used in several studies (10,29). This digital analysis permits accurate assessment of changes and distribution in hair density, hair diameter, and growth speed. Follicle-to-follicle matching can also evaluate changes at the follicular level (31). While these more precise and specific trichoscopy analyzers are likely to provide more precise hair analysis parameters, the associated financial cost of these devices means that they are not readily applicable for many clinicians involved in the treatment of hair loss. Hence, the more affordable digital microscopy used in the study was a useful "initial" adjunct for the analysis of hair density and provided a relatively crude measure of hair density following i-PRF+ treatment. Finally, the clinical photography provided an overall assessment of the changes in hair thickness and distribution of hair regrowth.

An interesting observation in a single participant was the darker color seen in the new hair shafts following the i-PRF+ treatment. Similar findings have been reported in people treated with PRP (32). To our knowledge, the change in color of de-pigmented hair has not been reported in any published clinical studies. Although the reason for this finding is not known, it has been speculated that the changes could be related to stimulation of melanocytes in the new hair follicles. This mechanism could be like the potential role for PRP in the treatment of vitiligo, an autoimmune disorder characterized by melanocyte destruction (33).

In this study, i-PRF+ was administered at a constant depth of 1.5–2.5 mm via the mesotherapy gun. This depth is consistent with the recommended depth of administration of APA therapy that targets growth factor receptors at the bulge level and the hair root (34). Unlike administration of APA treatment via manual injections or microneedling, the mesotherapy gun permitted a consistent depth of injection for the i-PRF+ treatment. The optimal amount of APA (i.e. i-PRF+ or PRP) to administer is also debatable. Some studies advocate injection volumes of 5–7 mL (34) versus the 4 mL used in our study. While injecting a larger volume might have produced some incremental benefit, the administered dose of 4 mL was considered sufficient with very little wastage observed. Three sessions of i-PRF+ at 1 month apart were performed, consistent with a minimum number of sessions and optimal time interval required for positive hair growth to be seen following administration of PRP (34). The added value of additional sessions of i-PRF+ treatment is not known.

Subjective assessment using the WAA-QoL was used before and after the treatment sessions. This evaluated the impact of FPHL on QoL with the i-PRF+ treatment. The significant improvements in QoL included an increase in confidence, feeling more attractive and an overall increased satisfaction with QoL. These findings are consistent with clinical outcomes observed with PRP for the treatment of AGA (10,29,30,35–38). Alongside these QoL benefits, all participants reported an improvement in cumulative hair thickness at the two follow-up visits and a reduction in hair loss by week 3 after the initial i-PRF+ treatment session.

In recent years, the treatment landscape for hair loss has expanded significantly, offering a range of non-surgical options such as PRP, microneedling, low-level light therapy, botulinum toxin, autologous stem cells, topical growth factors and exosome products among others (8,39–41). Clinicians often combine these treatments to leverage their different mechanisms of action for potentially enhanced results, although comparative data is still limited (8,42). The use of i-PRF+ treatment presents a promising addition, providing a time- and cost-effective option with the potential to improve treatment outcomes significantly. Unlike PRP, i-PRF+ is entirely autologous, eliminating the need for

anticoagulants or additives in its preparation. For any autologous platelet concentrate therapy, factors like age, gender, lifestyle and concomitant medical disorders can influence the quality of the obtained product and subsequent clinical outcomes (43).

Limitations are acknowledged with this study. First, only healthy, nonsmoking, females with Fitzpatrick scales of I, II and IV and Ludwig scale I/II were evaluated. Second, the lack of control group means there is a recognized potential procedural bias that may influence the reported subjective outcomes. This study was approved as case series, audit of practice, to assess both the objective and subjective outcomes, therefore preventing the use of control group or tests to evaluate the exact components of the i-PRF+ preparation administered to participants. An additional limitation is the relatively short follow-up period. This merits a longer-term study period with larger study population that would allow for the assessment of a range of additional variables (e.g., age range, different Ludwig and Fitzpatrick scales, social and medical history) for conclusive evaluation of i-PRF+ on FPHL.

Conclusion

In summary, this case series suggests that i-PRF+ is a safe and effective treatment for FPHL, rendering significant improvements in hair regrowth, hair density and QoL. Adverse effects were transient and mild. The exact mechanisms of action of iPRF+ at a cellular level, in hair follicles remains to be established. However, it appears that iPRF+ can be considered as a treatment modality alone or as an adjunct treatment for patients with FPHL, especially in those with greater severity of hair loss, or those who are either poor or non-responders to conventional treatment modalities.

Further evaluation is required to standardize protocols for administration of i-PRF+, including the optimal site of administration, depth, and angulation of the injections and the optimal number of treatment sessions. Further trials, comparing i-PRF+ with other treatment modalities, will be useful to ascertain the role of this APA in the treatment of FPHL.

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References

1. Kanti V, Messenger A, Dobos G, Reygagne P, Finner A, Blumeyer A, Trakatelli M, Tosti A, del Marmol V, Piraccini BM, et al. Evidence-based (S3) guideline for the treatment of androgenetic alopecia in women and in men - short version. J Eur Acad Dermatol Venereol. 2018;32(1):11–22. doi:10.1111/jdv.14624.
2. McMichael A, Female pattern hair loss (androgenetic alopecia in females): pathogenesis, clinical features, and diagnosis. Hordinsky M O editor, Riverwoods (IL): Wolters Kluwer; 2022.
3. Davis DS, Callender VD. Review of quality of life studies in women with alopecia. Int J Womens Dermatol. 2018;4(1):18–22. doi:10.1016/j.ijwd.2017.11.007.
4. Cervantes J, Perper M, Wong LL, Eber AE, Villasante Fricke AC, Wikramanayake TC, Jimenez JJ. Effectiveness of platelet-rich plasma for androgenetic alopecia: A review of the literature. Skin Appendage Disord. 2018;4(1):1–11. doi:10.1159/000477671.
5. Ahluwalia J, Fabi SG. The psychological and aesthetic impact of age-related hair changes in females. J Cosmet Dermatol. 2019;18(4):1161–69. doi:10.1111/jocd.12960.
6. Williamson D, Gonzalez M, Finlay AY. The effect of hair loss on quality of life. J Eur Acad Dermatol Venereol. 2001;15(2):137–39. doi:10.1046/j.1468-3083.2001.00229.x.
7. Gentile P, Garcovich S. Systematic review: The platelet-rich plasma use in female androgenetic alopecia as effective autologous treatment of regenerative plastic surgery. J Plast Reconstr Aesthet Surg. 2022;75(2):850–59. doi:10.1016/j.bjps.2021.11.004.
8. Kaiser M, Abdin R, Gaumond SI, Issa NT, Jimenez JJ. Treatment of androgenetic alopecia: Current guidance and unmet needs. Clin Cosmet Investig Dermatol. 2023;16:1387–406. doi:10.2147/CCID.S385861.
9. Elghblawi E. Platelet-rich plasma, the ultimate secret for youthful skin elixir and hair growth triggering. J Cosmet Dermatol. 2018;17(3):423–30. doi:10.1111/jocd.12404.
10. Starace M, Alessandrini A, D'Acunto C, Melandri D, Bruni F, Patrizi A, Piraccini BM. Platelet-rich plasma on female androgenetic alopecia: Tested on 10 patients. J Cosmet Dermatol. 2019;18(1):59–64. doi:10.1111/jocd.12550.
11. Mercuri SR, Paolino G, di NM, Vollono L. Investigating the safety and efficacy of platelet-rich plasma (PRP) treatment for female androgenetic alopecia: Review of the literature. Medicina (Kaunas). 2021;57(4):311. doi:10.3390/medicina57040311.
12. 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.
13. Shimizu Y, Ntege EH, Sunami H, Inoue Y. Regenerative medicine strategies for hair growth and regeneration: A narrative review of literature. Regen Ther. 2022;21:527–39. doi:10.1016/j.reth.2022.10.005.
14. Miron RJ, Fujioka-Kobayashi M, Hernandez M, Kandalam U, Zhang Y, Ghanaati S, Choukroun J. Injectable platelet rich fibrin (i-PRF): opportunities in regenerative dentistry? Clin Oral Investig. 2017;21(8):2619–27. doi:10.1007/s00784-017-2063-9.
15. Ghanaati S, Herrera-Vizcaino C, Al-Maawi S, Lorenz J, Miron RJ, Nelson K, Schwarz F, Choukroun J, Sader R. Fifteen years of platelet rich fibrin in dentistry and oromaxillofacial surgery: How high is the level of scientific evidence? J Oral Implantol. 2018;44(6):471–92. doi:10.1563/aaid-joi-D-17-00179.
16. Yu P, Zhai Z, Jin X, Yang X, Qi Z. Clinical application of platelet-rich fibrin in plastic and reconstructive surgery: A systematic review. Aesthetic Plast Surg. 2018;42(2):511–19. doi:10.1007/s00266-018-1087-0.
17. Choukroun J. Advanced PRF and i-PRF: Platelet concentrate or blood concentrate? J Periodontal Med Clin Pract. 2014;1(1):3.
18. Wang X, Zhang Y, Choukroun J, Ghanaati S, Miron RJ. Effects of an injectable platelet-rich fibrin on osteoblast behavior and bone tissue formation in comparison to platelet-rich plasma. Platelets. 2018;29(1):48–55. doi:10.1080/09537104.2017.1293807.

19. Choukroun J, Ghanaati S. Reduction of relative centrifugation force within injectable platelet-rich-fibrin (PRF) concentrates advances patients' own inflammatory cells, platelets and growth factors: the first introduction to the low speed centrifugation concept. Eur J Trauma Emerg Surg. 2018;44(1):87–95. doi:10.1007/s00068-017-0767-9.
20. Kobayashi E, Flückiger L, Fujioka-Kobayashi M, Sawada K, Sculean A, Schaller B, Miron RJ. Comparative release of growth factors from PRP, PRF, and advanced-PRF. Clin Oral Investig. 2016;20(9):2353–60. doi:10.1007/s00784-016-1719-1.
21. Hamid O, Quinlan DJ, Seemann R, Hassan H. Injectable platelet-rich fibrin for perioral rejuvenation as assessed by 3D lip volume imaging. J Cosmet Dermatol. 2021;20(10):3270–77. doi:10.1111/jocd.14394.
22. İzol BS, Üner DD. A new approach for root surface biomodification using injectable platelet-rich fibrin (I-PRF). Med Sci Monit. 2019;25:4744–50. doi:10.12659/MSM.915142.
23. Ozsagir ZB, Saglam E, Sen YB, Choukroun J, Tunali M. Injectable platelet-rich fibrin and microneedling for gingival augmentation in thin periodontal phenotype: A randomized controlled clinical trial. J Clin Periodontol. 2020;47(4):489–99. doi:10.1111/jcpe.13247.
24. Arora R, Shukla S. Injectable-platelet-rich fibrin-smart blood with stem cells for the treatment of alopecia: A report of three patients. Int J Trichology. 2019;11(3):128–31. doi:10.4103/ijt.ijt_73_18.
25. Shashank B, Bhushan M. Injectable platelet-rich fibrin (PRF): The newest biomaterial and its use in various dermatological conditions in our practice: A case series. J Cosmet Dermatol. 2021;20(5):1421–26. doi:10.1111/jocd.13742.
26. Dolte KS, Girman CJ, Hartmaier S, Roberts J, Bergfeld W, Waldstreicher J. Development of a health-related quality of life questionnaire for women with androgenetic alopecia. Clin Exp Dermatol. 2000;25(8):637–42. doi:10.1046/j.1365-2230.2000.00726.x.
27. Dhurat R, Saraogi P. Hair evaluation methods: merits and demerits. Int J Trichology. 2009;1(2):108–19. doi:10.4103/0974-7753.58553.
28. Biondo S, Sinclair R. Quality of life in Australian women with female pattern hair loss. Open Dermatol J. 2010;4(1):90–94. doi:10.2174/1874372201004010090.
29. Tawfik AA, Osman MAR. The effect of autologous activated platelet-rich plasma injection on female pattern hair loss: A randomized placebo-controlled study. J Cosmet Dermatol. 2018;17(1):47–53. doi:10.1111/jocd.12357.
30. Dubin DP, Lin MJ, Leight HM, Farberg AS, Torbeck RL, Burton WB, Khorasani H. The effect of platelet-rich plasma on female androgenetic alopecia: A randomized controlled trial. J Am Acad Dermatol. 2020;83(5):1294–97. doi:10.1016/j.jaad.2020.06.1021.
31. Stevens HP, Donners S, de Bruijn J. Introducing platelet-rich stroma: Platelet-rich plasma (PRP) and stromal vascular fraction (SVF) combined for the treatment of androgenetic alopecia. Aesthet Surg J. 2018;38(8):811–22. doi:10.1093/asj/sjy029.
32. Hair Loss Cure. Platelet rich plasma and hair darkening. [accessed Mar 31, 2024]. https://www.hairlosscure2020.com/platelet-rich-plasma-prp-and-hair-darkening/.
33. Pixley JN, Cook MK, Singh R, Larrondo J, McMichael AJ. A comprehensive review of platelet-rich plasma for the treatment of dermatologic disorders. J Dermatolog Treat. 2023;34(1):2142035. doi:10.1080/09546634.2022.2142035.
34. Sharma A, Chouhan K, Bhatia S, Dashore S. Platelet-rich plasma in androgenetic alopecia. Indian Dermatol Online J. 2021;12 (Suppl 1):S31–40. doi:10.4103/idoj.idoj_328_21.
35. Laird ME, Lo Sicco KI, Reed ML, Brinster NK. Platelet-rich plasma for the treatment of female pattern hair loss: A patient survey. Dermatol Surg. 2018;44(1):130–32. doi:10.1097/DSS.0000000000001109.
36. El-Husseiny RM, Saleh HM, Moustafa AA, Salem SA. Comparison between single- versus double-spin prepared platelet-rich plasma injection in treatment of female pattern hair loss: clinical effect and relation to vascular endothelial growth factor. Arch Dermatol Res. 2021;313(7):557–66. doi:10.1007/s00403-020-02134-6.
37. Syed MA, Abushaikha SS. Platelet-rich plasma for androgenetic alopecia in women: A single-center case series study in Qatar. Int J Dermatol Venereol. 2020;3(4):228–30. doi:10.1097/JD9.0000000000000120.
38. Zhou S, Qi F, Gong Y, Zhang C, Zhao S, Yang X, He Y. Platelet-rich plasma in female androgenic alopecia: A comprehensive systematic review and meta-analysis. Front Pharmacol. 2021;12:642980. doi:10.3389/fphar.2021.642980.
39. Krefft-Trzciniecka K, Piętowska Z, Pakiet A, Nowicka D, Szepietowski JC. Short-term clinical assessment of treating female androgenetic alopecia with autologous stem cells derived from human hair follicles. Biomedicines. 2024;12(1):153. doi:10.3390/biomedicines12010153.
40. Ng M. Umbilical cord lining mesenchymal exosomes with microneedling for scalp rejuvenation. Oral presentation at the 25th World Congress of Dermatology; 2023 July 3–8. Singapore.
41. Buontempo MG, Alhanshali L, Ide M, Shapiro J, Lo Sicco K. Examining the uncertainties surrounding exosome therapy in androgenetic alopecia: A call for evidence-based practice. J Drugs Dermatol. 2024;23(3):e86–90. doi:10.36849/jdd.7603.
42. Vesala A-M, Nacopoulos C, Karypidis D, Ruga E. Efficacy of microneedling with injectable platelet-rich fibrin (i-PRF) for facial skin rejuvenation. Int J Dermatol Venereol. 2023;Publish Ahead of Print. doi:10.1097/JD9.0000000000000301.
43. Karaborklu AS, Celik D, Naci Ergin ON, Kilicoglu OI. Factors affecting the features of platelet-rich plasma in patients with knee osteoarthritis. Acta Orthop Traumatol Turc. 2023;57(4):148–53. doi:10.5152/j.aott.2023.22077.