# Platelet-Rich Plasma for Hair Restoration

Natalie Justicz, MD, Adeeb Derakhshan, MD, Jenny X. Chen, MD, Linda N. Lee, MD*

**KEYWORDS**

• Hair restoration • Platelet-rich plasma (PRP) • Androgenic alopecia • Growth factors • Hair loss

**KEY POINTS**

- Platelet-rich plasma (PRP) has been used to promote wound healing across a number of medical fields; more recently, the growth factor concentrate has become of interest for physicians interested in hair restoration.
- Androgenic alopecia (AGA) is a disease of progressive hair loss mediated by systemic androgens and other genetic factors; patients seeking PRP for hair restoration are commonly those with AGA who have not experienced success with finasteride or minoxidil.
- PRP is injected into areas of hair loss using a small-gauge needle, with most described techniques involving injections of small aliquots of PRP into areas of hair loss.
- PRP is a promising treatment for hair restoration in patients with AGA, and many studies of hair restoration with PRP report positive outcomes. Further research seeks to optimize PRP preparation/administration procedures and identify patient populations that benefit most from this treatment.

## INTRODUCTION

Hair loss is treated with a wide range of clinical therapies including low-level laser light therapy as well as 2 medications approved by the Food and Drug Administration (FDA): topical minoxidil and oral finasteride. Surgical options include follicular unit transplant (FUT) and follicular unit extraction (FUE) techniques, which are outpatient procedures with excellent outcomes. In addition to these existing medical and surgical options, platelet-rich plasma (PRP) is a novel, minimally invasive, office-based procedure used to treat hair loss, typically secondary to androgenic alopecia (AGA). PRP consists of growth factors extracted from autologous blood obtained by venipuncture. This concentrated mix of growth factors is injected into areas of hair loss, stimulating hair regrowth.

## BACKGROUND

PRP (sometimes called platelet-rich growth factors or platelet concentrate) was described in the field of hematology in the 1970s.[1] Hematologists coined the term PRP to describe a high-platelet product used for the treatment of thrombocytopenia. Within the fields of orthopedics and sports medicine, PRP has been shown to stimulate soft tissue and joint healing due to its high concentration of growth factors. Since the 1990s, PRP has been used to promote wound healing across a number of medical fields, including the following:

- Ophthalmology
- Oral maxillofacial surgery
- Cardiac surgery
- Gynecology
- Urology[2,3]

Department of Otolaryngology–Head and Neck Surgery, Harvard Medical School, Massachusetts Eye and Ear Infirmary, 243 Charles Street, Boston, MA 02114, USA
* Corresponding author.
*E-mail address:* linda_lee@meei.harvard.edu

Facial Plast Surg Clin N Am ■ (2020) ■–■
https://doi.org/10.1016/j.fsc.2020.01.009

More recently, PRP has become of interest to facial plastic surgeons, dermatologists, and those interested in its possible aesthetic applications and additional off-label uses.

According to the FDA, blood products like PRP fall under regulations set forth by the Center for Biologics Evaluation and Research, which regulates human cells, tissues, and cellular and tissue-based products.[4] Certain products, including growth factors like PRP, are exempt and therefore do not follow the FDA's traditional regulatory pathway (which necessitates animal studies and clinical trials).[4] Nearly all preparatory systems for PRP were designed to generate platelet concentrate to be mixed with bone graft material for orthopedic applications.[4] However, PRP is used for a wide range of off-label applications. Uses for PRP in the field of facial plastic and reconstructive surgery include the following:

- Soft tissue augmentation[5]
- Skin rejuvenation[6,7]
- Wound healing[8,9]
- Hair restoration

A review by Sand and colleagues[10] examined the early body of evidence for PRP in aesthetic surgery, including hair loss and facial rejuvenation. They concluded that PRP is a promising new therapy for AGA. One of the earliest articles on PRP for AGA was published in 2006 by Uebel and colleagues,[11] who described a 15% greater hair yield in follicular unit density in areas pretreated with PRP as compared with controls. This inspired interest and fueled the development of PRP technology for hair restoration and spurred its clinical adoption. A more recent systematic review paper by Chen and colleagues[12] examined PRP for hair restoration specifically in patients with AGA. Patient demographics, frequency of treatment, hair count, and hair density following PRP therapy were analyzed with promising results.[12] The hair restoration community is continuing to invest considerable time and resources in the development PRP therapies.

## PLATELET-RICH PLASMA MECHANISM OF ACTION

Many growth factors have been identified in PRP, including platelet-derived growth factor, transforming growth factor-β, vascular endothelial growth factor, epidermal growth factor, and insulinlike growth factor. These factors are present in much higher concentrations (by a factor of 5 to 8 times) in PRP than in whole blood, and PRP has been shown to induce the proliferation of dermal papilla cells by upregulating fibroblast growth factor-7, beta-catenin, and ERK/Akt signaling through these factors.[13] Although these growth factors are upregulated in PRP, the precise biological pathways by which PRP promotes hair restoration remain largely unknown. One proposed mechanism is that growth factors released from platelets act on the bulge area of hair follicles where stem cells are found, stimulating the development of new follicles and promoting neovascularization.[11,14]

## PREPROCEDURE CONSIDERATIONS AND TESTING

Patients seeking PRP for hair restoration are commonly those who have not experienced success with finasteride or minoxidil for the treatment of AGA. AGA is a disease of progressive hair loss mediated by systemic androgens and other genetic factors. It is the most common type of hair loss for patients of both genders. AGA affects more than 73% of men and more than 57% of women by the age of 80.[15,16] As much as 58% of the male population between 30 and 50 years of age have AGA.[17] Many patients present to primary care providers, dermatologists, plastic surgeons, and otolaryngologists for counseling regarding hair restoration therapies.

As in any encounter leading to a prescription medication or procedural treatment, a full history and physical examination (H&P) are imperative for diagnosis of AGA. This H&P includes a detailed medical history, medication history, and clinical examination. Laboratory tests should be performed to exclude other causes of hair loss, such as anemia, malnutrition, and thyroid dysfunction. Labwork often includes a complete blood cell count, as well as a measurement of serum levels of iron, serum ferritin, total iron-binding capacity, and folic acid. Thyroid function laboratory tests include T3, T4, thyroid-stimulating hormone, and antithyroid peroxidase. Other endocrine tests may include a measure of testosterone and other hormones. Autoimmune markers such as antinuclear antibodies may be examined. Some physicians, but not all, confirm the diagnosis of AGA with scalp biopsy. Once other medical causes of hair loss have been excluded, the patient and physician can consider the use of medications and treatments. Many patients with AGA start by trying FDA-approved medications. If topical minoxidil and/or oral finasteride do not provide significant improvement, patients become more willing to investigate more invasive procedures.

PRP does not take the place of hair transplantation via FUT or FUE. Rather, it should be considered in patients who may wish to stabilize hair

loss or who are not ready to move forward with transplantation, acting as a standalone procedure to maintain or improve hair density and hair count. It also can be considered as an adjunct to hair transplantation.

Some additional contraindications exist when determining whether a patient is safe for PRP therapy. Patients with coagulopathies are generally not considered good candidates for PRP therapy and have largely been excluded from trials based on concern for periprocedural bleeding. Patients on anticoagulation or antiplatelet medications (such a clopidogrel or aspirin) also should be considered carefully, as they also may be at higher risk for bleeding. Moreover, as the mechanism of PRP may be related to the concentration and activity of platelets and platelet-derived factors, patients on antiplatelet medications were excluded from most studies to date, and therefore it is unclear whether they will see the same benefits. Reassuringly, a study within the cardiac surgery literature shows no statistical evidence of decreased growth factors delivered to the surgical wound site in the presence of aspirin and/or clopidogrel use,[18] but it is unclear whether this is generalizable to hair restoration treatments with PRP.

## PLATELET-RICH PLASMA PREPARATION

PRP is prepared from a patient's autologous blood sample. A 18-mL to 30-mL venous blood draw yields 3 to 5 mL of PRP depending on the harvesting technique or preparation kit. There are many methods of creating PRP, but most have some steps in common. Blood is collected in tubes lined with anticoagulant, which are immediately centrifuged to separate the blood into 3 layers: red blood cells (RBCs) at the bottom, acellular plasma (PPP, platelet-poor plasma) is in the supernatant, and a buffy coat layer appears in the middle where platelets and leukocytes are concentrated in PRP (**Figs. 1** and **2**).[3] The subsequent steps vary between protocols as to which layers are harvested, but there is a general attempt to discard much of both the RBC layer and the PPP to collect only the material surrounding the buffy coat. After platelet-poor fluid has been discarded, the resultant platelet concentrate is applied to the surgical site. The time for platelet concentrate preparation can typically be completed in less than 1 hour.

## PLATELET-RICH PLASMA ADMINISTRATION

PRP is injected into areas of hair loss using a small-gauge needle, such as a 30-gauge needle or an insulin syringe. Although PRP has also been used in the literature as a topical spray,[19,20] the vast majority of described techniques involve injections of small aliquots of PRP into the subcutaneous layer of the scalp. A local anesthetic, such as lidocaine, can be used, although most described techniques in the literature do not describe the use of a numbing agent. Lidocaine is not reported to disrupt hair growth, although this has not been well-studied. Alternatively, topical analgesia also can be applied as well as ice for vasoconstriction. In addition, the Zimmer cooler from a laser can be used during the injection for comfort.

Treatment areas can include the frontal, parietal, and occipital scalp. Typically, activated PRP is used, created by treating PRP with calcium chloride to activate platelets. Chen and colleagues[12] found that most studies used more than 1 treatment of PRP per patient, with most offering between 3 and 6 treatments with 1 month between injections. Patients should therefore be counseled to expect multiple rounds of treatment to maximize results.

## POSTPROCEDURE CONSIDERATIONS

Few studies have noted any complications from PRP treatment. Some report temporary pain during injections[20,21] and transient edema/erythema at the injection site.[14,22] No allergic reactions, hematomas, or infections have been documented.

Patients can be counseled that there is no contraindication to showering or exercising following treatment. No antibiotic is needed. Most patients are able to return to work the next day. No significant or lasting swelling is anticipated.

## PLATELET-RICH PLASMA OUTCOMES

Multiple retrospective studies, prospective trials, and systematic reviews suggest that PRP may be a promising new treatment for AGA. However, additional research is still needed to optimize the use of PRP for hair restoration.

The best use of PRP in terms of preparation, activation, and treatment regimens is unknown. Dohan Ehrenfest and colleagues[3] described a classification system of platelet concentrates based on preparatory process and leukocyte and fibrin content: P-PRP (pure PRP), L-PRP (leucocyte-rich plasma and PRP), P-PRF (pure platelet-rich fibrin) and L-PRF (leukoocyte-rich fibrin and PRF). Most published studies to date use an L-PRP derivate.[12]

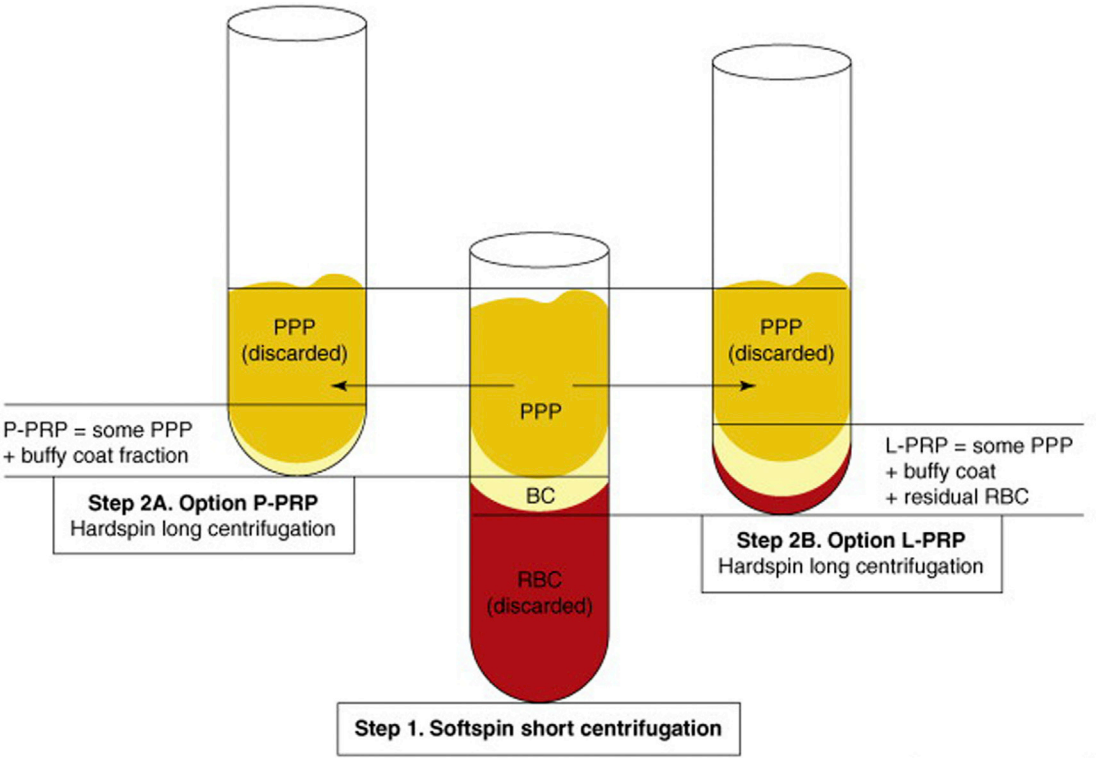


**Fig. 1.** Following centrifugation of a patient's whole blood, the sample is separated into 3 layers. The top supernatant component consists of PPP, and the bottom layer is composed of red blood cells (RBCs) or erythrocytes. The middle "buffy coat" (BC) layer contains the desired platelets and growth factors along with leukocytes. (*From* Dohan Ehrenfest DM, Rasmusson L, Albrektsson T. Classification of platelet concentrates: from pure platelet-rich plasma (P-PRP) to leucocyte- and platelet-rich fibrin (L-PRF). Trends Biotechnol. 2009;27(3):159; with permission.)

In the largest systematic review by Chen and colleagues,[12] 21 of 24 studies examining the effect of PRP on hair restoration reported positive outcomes (88%), both subjective and objective. Thirteen studies (54%) reported statistically significant improvement in at least 1 outcome that could be measured objectively. Hair counts or hair densities were described by 16 studies[14,21–35] and of these, 12 found statistically significant improvements in this outcome. Among studies with the highest level of evidence, 6 (75%) of 8 randomized controlled trials (RCTs) reported positive treatment outcomes. Three studies did not report positive findings after PRP administration, including 2 RCTs,[31,36] but these continued to report high patient satisfaction treatment results.

Future research should study the use of PRP in combination with minoxidil and finasteride. Most studies have excluded patients taking topical or oral medication within a certain period of study initiation (eg, 60 days or 12 months) so as avoid confounding results. However, for many patients it could make sense to try topical and oral medications in conjunction with PRP to maximize hair restoration potential. These patients would still be candidates for FUT and FUE hair transplant technology, which can be completed in conjunction with PRP therapy.

As patients with AGA can be affected at a young age, longer follow-up of patients is required to determine whether this treatment has long-lasting effects or whether repeated injections could be considered. In the literature, the shortest follow-up time for studies was 6 weeks and the longest was 1 year.[12] In addition, only 28% of patients in the systematic review performed by Chen and colleagues[12] were female; there remains limited information on potential gender differences in the effect of PRP.

The preponderance of evidence related to PRP and hair restoration is positive. It is becoming a more common procedure in hair restoration practices. Clinicians should familiarize themselves with the expanding repertoire of hair restoration treatments available to patients to provide individualized hair loss therapy.

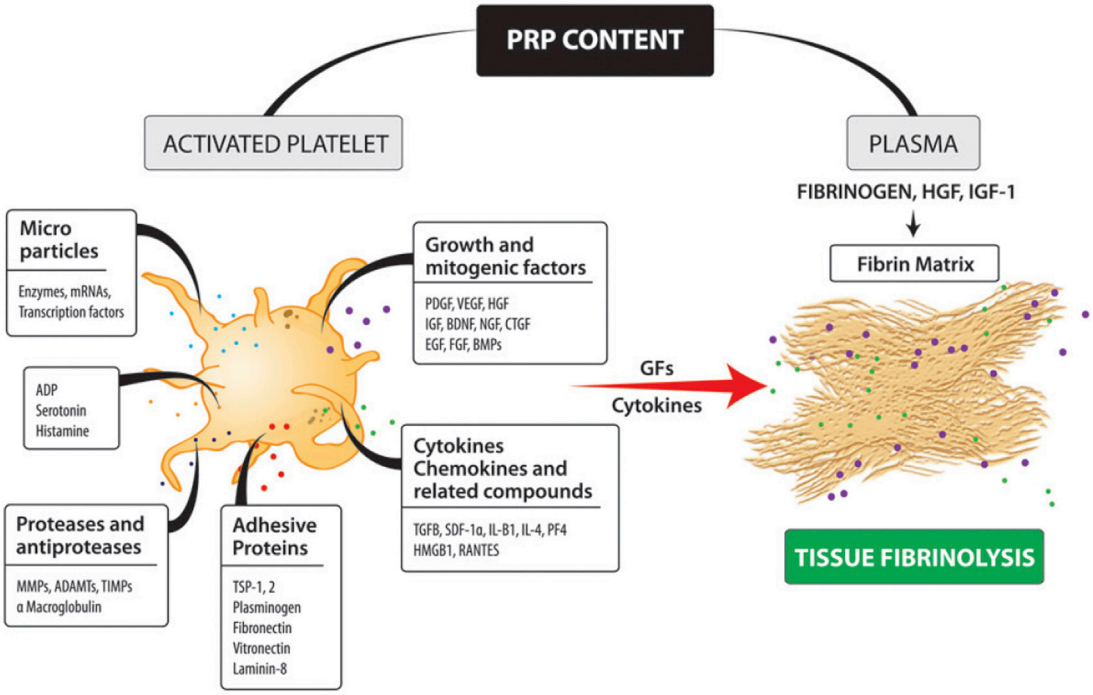


**Fig. 2.** Biological mediators of PRP that govern tissue repair by still poorly understood mechanisms. There are biomolecules and several growth factors that come either from platelet activation and plasma or both. Several of these bioactive mediators and other growth factors or proteins remain trapped through fibrin heparan sulfate–binding domains, in a 3-dimensional transient fibrin matrix to be released later by tissue fibrinolysis. ADAMTs, a disintegrin and metalloprotease with thrombospondin motifs; ADP, adenosine diphosphate; BDNF, brain-derived neurotrophic factor; BMPs, bone morphogenetic proteins; CTGF, connective tissue growth factor; EGF, epidermal growth factor; FGF, fibroblast growth factor; GFs, growth factors; HGF, hepatocyte growth factor; HMGB1, high mobility group box 1; IGF, insulinlike growth factor; IL-β1, interleukin-β1; MMPs, matrix metalloproteinases; NGF, nerve growth factor; PDGF, platelet-derived growth factor; PF4, platelet factor 4; RANTES, regulated upon activation, normal T cell expressed and presumably secreted; SDF-1α, stromal cell–derived factor-1α; TGFB, transforming growth factor beta; TIMPs, tissue inhibitors of metalloproteinases; TSP-1, thrombospondin-1; VEGF, vascular endothelial growth factor. (*From* Sánchez M, Garate A, Delgado D, et al. Platelet-rich plasma, an adjuvant biological therapy to assist peripheral nerve repair. Neural Regen Res 2017;12:47-52; with permission.)

## SUMMARY

PRP is a promising treatment for hair restoration in patients with AGA. Created from a platelet concentrate from an autologous blood draw, PRP is a safe therapeutic option for patients with hair loss. It can be used alone or in conjunction with topical and oral therapies. PRP may also be administered before FUT or FUE.

Most studies of hair restoration with PRP report positive outcomes. Further research to optimize PRP preparation/administration procedures and identify patient populations that benefit most from this treatment are needed, in addition to long-term follow-up of objective hair loss outcomes. PRP appears to be a safe technology with excellent potential for promoting hair restoration.

## DISCLOSURE

The authors have nothing to disclose.

## REFERENCES

1. Matras H. Effect of various fibrin preparations on reimplantations in the rat skin. Osterr Z Stomatol 1970; 67(9):338–59 [in German].
2. Marx RE, Carlson ER, Eichstaedt RM, et al. Platelet-rich plasma: growth factor enhancement for bone grafts. Oral Surg Oral Med Oral Pathol Oral Radiol Endod 1998;85:638–46.
3. Dohan Ehrenfest DM, Rasmusson L, Albrektsson T. Classification of platelet concentrates: from pure platelet-rich plasma (P-PRP) to leucocyte- and platelet-rich fibrin (L-PRF). Trends Biotechnol 2009; 27(3):158–67.

4. Beitzel K, Allen D, Apostolakos J, et al. US definitions, current use, and FDA stance on use of platelet-rich plasma in sports medicine. J Knee Surg 2015;28(1):29–34.
5. Ulusal BG. Platelet-rich plasma and hyaluronic acid - an efficient biostimulation method for face rejuvenation. J Cosmet Dermatol 2017;16(1):112–9.
6. Asif M, Kanodia S, Singh K. Combined autologous platelet-rich plasma with microneedling verses microneedling with distilled water in the treatment of atrophic acne scars: a concurrent split-face study. J Cosmet Dermatol 2016;15(4):434–43.
7. Shin M-K, Lee J-H, Lee S-J, et al. Platelet-rich plasma combined with fractional laser therapy for skin rejuvenation. Dermatol Surg 2012;38(4):623–30.
8. Kang J-S, Zheng Z, Choi MJ, et al. The effect of CD34+ cell-containing autologous platelet-rich plasma injection on pattern hair loss: a preliminary study. J Eur Acad Dermatol Venereol 2014;28(1):72–9.
9. Sclafani AP, Azzi J. Platelet preparations for use in facial rejuvenation and wound healing: a critical review of current literature. Aesthetic Plast Surg 2015;39(4):495–505.
10. Sand JP, Nabili V, Kochhar A, et al. Platelet-rich plasma for the aesthetic surgeon. Facial Plast Surg 2017;33(04):437–43.
11. Uebel CO, da Silva JB, Cantarelli D, et al. The role of platelet plasma growth factors in male pattern baldness surgery. Plast Reconstr Surg 2006;118(6):1458–66.
12. Chen JX, Justicz N, Lee LN. Platelet-rich plasma for the treatment of androgenic alopecia: a systematic review. Facial Plast Surg 2018;34(6):631–40.
13. Gupta AK, Carviel J. A mechanistic model of platelet-rich plasma treatment for androgenetic alopecia. Dermatol Surg 2016;42(12):1335–9.
14. Khatu SS, More YE, Gokhale NR, et al. Platelet-rich plasma in androgenic alopecia: myth or an effective tool. J Cutan Aesthet Surg 2014;7(2):107–10.
15. Hamilton JB. Patterned loss of hair in man: types and incidence. Ann N Y Acad Sci 1951;53(3):708–28.
16. Gan DCC, Sinclair RD. Prevalence of male and female pattern hair loss in Maryborough. J Investig Dermatol Symp Proc 2005;10(3):184–9.
17. Krupa Shankar D, Chakravarthi M, Shilpakar R. Male androgenetic alopecia: population-based study in 1,005 subjects. Int J Trichology 2009;1(2):131–3.
18. Smith CW, Binford RS, Holt DW, et al. Quality assessment of platelet rich plasma during antiplatelet therapy. Perfusion 2007;22(1):41–50.
19. James R, Chetry R, Subramanian V, et al. Platelet-rich plasma growth factor concentrated spray (Keratogrow®) as a potential treatment for androgenic alopecia. J Stem Cells 2016;11(4):183–9.
20. Farid CI, Abdelmaksoud RA. Platelet-rich plasma microneedling versus 5% topical minoxidil in the treatment of patterned hair loss. J Egypt Women's Dermatol Soc 2016;13(1):29.
21. 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 2017. https://doi.org/10.1111/jocd.12357.
22. Anitua E, Pino A, Martinez N, et al. The effect of plasma rich in growth factors on pattern hair loss: a pilot study. Dermatol Surg 2017;43(5):658–70.
23. Kachhawa D, Vats G, Sonare D, et al. A spilt head study of efficacy of placebo versus platelet-rich plasma injections in the treatment of androgenic alopecia. J Cutan Aesthet Surg 2017;10(2):86–9.
24. Rodrigues BL, Montalvão SADL, Annichinno-Bizzacchi J, et al. The therapeutic response of platelet rich plasma (PRP) for androgenetic alopecia showed no correlation with growth factors and platelet number. Blood 2016;128(22):2637.
25. Borhan R, Gasnier C, Reygagne P. Autologous platelet rich plasma as a treatment of male androgenetic alopecia: study of 14 cases. J Clin Exp Dermatol Res 2015;6(4). https://doi.org/10.4172/2155-9554.10000292.
26. Gkini M-A, Kouskoukis A-E, Tripsianis G, et al. Study of platelet-rich plasma injections in the treatment of androgenetic alopecia through an one-year period. J Cutan Aesthet Surg 2014;7(4):213–9.
27. Marwah M, Godse K, Patil S, et al. Is there sufficient research data to use platelet-rich plasma in dermatology? Int J Trichology 2014;6(1):35–6.
28. Sclafani AP. Platelet-rich fibrin matrix (PRFM) for androgenetic alopecia. Facial Plast Surg 2014;30(2):219–24.
29. Takikawa M, Nakamura S, Nakamura S, et al. Enhanced effect of platelet-rich plasma containing a new carrier on hair growth. Dermatol Surg 2011;37(12):1721–9.
30. Gentile P, Cole JP, Cole MA, et al. Evaluation of not-activated and activated PRP in hair loss treatment: role of growth factor and cytokine concentrations obtained by different collection systems. Int J Mol Sci 2017;18(2). https://doi.org/10.3390/ijms18020408.
31. Puig CJ, Reese R, Peters M. Double-blind, placebo-controlled pilot study on the use of platelet-rich plasma in women with female androgenetic alopecia. Dermatol Surg 2016;42(11):1243–7.
32. Gentile P, Garcovich S, Bielli A, et al. The effect of platelet-rich plasma in hair regrowth: a randomized placebo-controlled trial. Stem Cells Transl Med 2015;4(11):1317–23.

33. Alves R, Grimalt R. Randomized placebo-controlled, double-blind, half-head study to assess the efficacy of platelet-rich plasma on the treatment of androgenetic alopecia. Dermatol Surg 2016; 42(4):491–7.
34. Cervelli V, Garcovich S, Bielli A, et al. The effect of autologous activated platelet rich plasma (AA-PRP) injection on pattern hair loss: clinical and histomorphometric evaluation. Biomed Res Int 2014;2014: 760709.
35. Kang R, Nimmons GL, Drennan W, et al. Development and validation of the university of washington clinical assessment of music perception test. Ear Hear 2009;30(4):411–8.
36. Mapar MA, Shahriari S, Haghighizadeh MH. Efficacy of platelet-rich plasma in the treatment of androgenetic (male-patterned) alopecia: a pilot randomized controlled trial. J Cosmet Laser Ther 2016;18(8): 452–5.