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# Application of hair transplantation combined with platelet-rich plasma injection for the treatment of androgenic alopecia

*Background:* Androgenic alopecia is a type of hair loss condition that is influenced by both genetic and environmental factors. *Objective*: This study aimed to investigate the effectiveness of combining hair transplantation with platelet-rich plasma injection for treating androgenic alopecia. *Materials & Methods*: From June 2019 to September 2021, a total of 147 patients with androgenic alopecia were selected and treated by our department. Out of these, 72 patients were assigned to the treatment group and received hair transplantation along with platelet-rich plasma treatment. The remaining 75 cases constituted the control group, receiving only hair transplantation. Clinical data was obtained by reviewing the patients' medical records and case reports. *Results:* The area of hair loss in the treatment group was significantly smaller than that in the control group. The score of the hair pulling test in the treatment group was significantly lower than that in the control group. The hair regeneration score in the treatment group was significantly higher than that in the control group. After treatment, the total area of skin lesions in the treatment group was significantly reduced compared to the control group. There was a statistically significant difference between the two groups. *Conclusion:* Our study indicates that combining hair transplantation with platelet-rich plasma is superior to hair transplantation alone for the treatment of androgenic alopecia. This combination therapy shows promising potential for clinical applications.

**Key words:** hair transplantation, platelet-rich plasma injection, androgenic alopecia

Androgenic alopecia (AGA) is the most prevalent type of hair loss in clinical practice, characterized by a progressive reduction in hair density, changes in the hair growth cycle, and alterations in the microstructure of hair follicles [1]. According to statistics, the incidence of AGA in males can be as high as 21.3%, while in females, it is approximately 6.0% [2]. The precise mechanisms underlying the development of AGA are not completely understood [2]. However, within the field of hair science, it is generally acknowledged that AGA is an autosomal dominant genetic disorder influenced by androgens [3]. The pathogenesis of AGA involves genetic susceptibility, hormone metabolism, inflammation reactions in the hair follicle microenvironment, and psychological factors [4, 5]. It is important to note that this response should not be considered medical advice, and consulting a healthcare professional is recommended for further understanding or treatment options.

The main clinical manifestation of androgenic alopecia is the progressive reduction of hair density, accompanied by an increase in scalp seborrhoea, dandruff, scalp pruritus, and other symptoms. These symptoms cause significant psychological and physical problems for patients [6, 7]. Currently, the clinical treatment duration of AGA is long, and the guideline mainly recommends methods that inhibit type II 5α reductase. However, antiandrogens and topical minoxidil have limited therapeutic efficacy [8-10].

Platelet-rich plasma (PRP) contains autologous platelets with a concentration 4-7 times greater than normal [11]. Currently, it is utilized for various skin conditions, including wound healing and for both medical and aesthetic purposes, due to its anti-inflammatory properties [11]. PRP is abundant in several growth factors stored within alpha particles and dense particles found in platelets [12]. The granules contain seven essential growth factors, including platelet-derived growth factors (PDGFaa, PDGFBB, and PDGFab), transforming growth factors-beta (TGF-β1 and TGF-β2), epithelial growth factor (EGF), and vascular endothelial growth factor (VEGF) [13]. These growth factors play a significant role in regulating cell proliferation, differentiation, and inducing angiogenesis. Dense particles found in PRP

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contain bioactive factors such as serotonin, histamine, dopamine, calcium, and adenosine [14]. These bioactive factors enhance the permeability of cell membranes and regulate the inflammatory response. Pure PRP is the most commonly utilized form in clinical practice [15]. The preparation method involves collecting venous blood and centrifuging it to obtain plasma rich in a high number of platelets and a small population of white blood cells, separating it from the supernatant of the red blood cells [16]. Platelet-activating agents, such as thrombin or calcium chloride, are added to activate the PRP [17]. Currently, this method is widely employed in cosmetic dermatology, especially in the treatment of androgenic alopecia [18].

Hair transplantation is a surgical procedure that involves extracting hair follicles from the occipital scalp and implanting them into the forehead and areas affected by baldness [19]. The roots of modern hair transplantation technology can be traced back to the 19$^{th}$ century, but significant development began in the mid-20$^{th}$ century [20]. The theory of donor dominance suggests that hair follicles taken from the occipital scalp, which are resistant to androgens, can be transplanted into the bald areas sensitive to androgens while retaining their original characteristics from the donor area. This theory provides a foundation for hair transplantation [21]. The evolution of hair transplantation techniques includes bald scalp reduction surgery, scalp autotransplantation, and hair follicle unit transplantation [22]. Over time, the size of units used in transplantation has become smaller, progressing from small skin grafts to ring drill hair embryo transfer, micro hair embryo transfers, and finally, micro hair embryo transfers [23]. As modern technology has advanced, transplanted hair follicles have become permanent, with a graft survival rate exceeding 90% [23]. Hair follicle unit transplantation is now widely practiced in clinical settings [24]. This study explored the efficacy of combining hair transplantation with PRP injections for the treatment of androgenic alopecia.

## Materials and methods

### General information

From June 2019 to September 2021, 147 patients with androgenic alopecia treated by the author's department were selected, of which 72 patients received hair transplantation and PRP treatment as the treatment group. In addition, 75 cases only received hair transplantation as control group. Clinical data were obtained by reviewing the patients' medical records and case reports. The written informed consents were obtained from all the subjects and this study was approved by the Ethics Committee of The Second Affiliated Hospital of Anhui Medical University (NO: 20190126L142).

### Inclusion and exclusion criteria

#### Inclusion criteria

The inclusion criteria corresponded to the diagnostic criteria for androgenic alopecia in patients who have not used glucocorticoids or used glucocorticoids that have been stopped for more than half a year.

#### Exclusion criteria

Exclusion criteria included: (1) pregnant and lactating women; (2) the presence of other systemic diseases; (3) sparse hair due to congenital factors; (4) hair thinning due to drugs or other acquired factors; and (5) hair loss due to other diseases.

### Treatment and evaluation methods

All the patients in both groups received hair transplantation. After disinfection, the occipital part was covered with a towel and injected with 1% lidocaine for local infiltration and nerve block anaesthesia. The hair follicles were extracted to the required amount by an electric hair follicle extractor. After the hair follicles were separated, they were put into sterile saline gauze and stored at 0°C for refrigeration. Disinfect and spread towels were applied in the bald area, and the patients were injected with 1% lidocaine for local infiltration + nerve block anaesthesia. The distribution of gemstone cleft and knife point was adopted, and the hair follicle was planted with hair implantation forceps.

The treatment group was treated with PRP, four weeks after hair transplantation. A total of 100 mL of venous blood was extracted from the patients, with a vacuum blood collection tube containing anticoagulant, 10 mL per tube. PRP was prepared according to the ratio of total blood volume to PRP volume, of 10:1. Vacuum blood (10 mL) was centrifuged at 2400r/min for 10 minutes using a low-speed bench centrifuge, the red blood cell layer at the bottom was then discarded, and the middle layer (PRP) and upper layer (platelet poor plasma) were transferred to another 10-mL centrifuge tube. Samples were centrifuged at 360r/min for 15 minutes; the upper layer corresponded to the platelet-poor plasma layer and the lower layer to the platelet concentrate and white blood cells. The lower layer of PRP was collected for further use. Before treatment, normal saline was used to clean the bald area and compound lidocaine cream was applied locally. The applied area was then wrapped with plastic wrap for 30 minutes. Afterwards, the area with compound lidocaine cream was wiped and washed with normal saline. The local area was disinfected with Anle iodine, and the PRP was injected with a Demassa water light injection instrument. The injection site was 1 cm in diameter and divided into five pinholes with an interval of 0.2 cm. After the injection, the injection site was raised locally with a small colliculus.

Hair growth of the hair loss area was observed before and eight weeks after treatment, and the area of hair loss, hair pulling test, skin lesion and clinical effect were compared before and after treatment.

### Indicators and evaluation criteria

At present, there is no authoritative therapeutic standard for alopecia, therefore the evaluation standard was established according to clinical experience.

Scores for the hair loss area were as follows: 0=no visible non-physiological alopecia; 1=alopecia is present on the scalp, but the total area of alopecia is less than half of the scalp area; 2=alopecia is present on the scalp, and the alopecia area is more than half of the scalp area, but there are still some areas of the scalp without alopecia; 3=hair loss exists in all areas; and 4=no hair is present. For the light pull test: 0=negative; 1=positive.

### Evaluation of clinical efficacy

Full recovery corresponded to disappearance of hair loss symptoms, the hair regeneration rate reaching 100%, and shape and appearance of new hair similar to that of normal hair, with restoration of scalp secretion. A significant effect corresponded to disappearance of hair loss symptoms, regeneration of the hair to 70%~99%, essentially normal shape and appearance of new hair, and significantly reduced sebum secretion by the scalp. An effective response corresponded to disappearance of hair loss symptoms and hair regeneration reaching 30%~69%. An ineffective response corresponded to the continued presence of hair loss symptoms, or a hair regeneration rate of less than 30%.

### Statistical analysis

Graphad Prism 6 was used for statistical analysis. All values were expressed as mean±SEM unless specified. $P<0.05$ was considered statistically significant. The differences between groups were analysed using the Student's *t*-test.

## Results

### Comparison of hair loss area scores before and after treatment

The impact of treatment on hair loss was investigated by comparing hair loss area scores before and after intervention for the treatment and control group. The findings showed that, post-treatment, the hair loss area decreased in both groups compared to pre-treatment (*table 1*). However, the treatment group exhibited a significantly smaller hair loss area than the control group (*table 1*).

### Comparison of hair pulling test scores before and after treatment

We then investigated the effect of hair transplantation combined with PRP injection on hair pulling test scores in patients with androgenic alopecia. Following the treatment, the scores of the hair pulling test were found to be lower in both groups compared to before the treatment (*table 2*). Notably, the treatment group exhibited a significantly lower score on the hair pulling test compared to the control group (*table 2*).

### Comparison of hair regeneration scores before and after treatment

We then analysed the effects of hair transplantation combined with PRP injection on hair regeneration scores in patients with androgenic alopecia. Following the treatment, both groups showed a decrease in hair regeneration scores compared to their baseline levels (*table 3*). Notably, the treatment group exhibited significantly lower hair regeneration scores compared to the control group (*table 3*).

### Comparison of total lesion area before and after treatment

A further analysis was performed on the effects of combining hair transplantation with PRP injection on hair regeneration scores in patients with androgenic alopecia. The results revealed that the total area of skin lesions in both treatment groups decreased after the intervention, as compared to before treatment (*table 4*). Moreover, it was observed that the treatment group had a significantly smaller total area of skin lesions compared to the control group after treatment (*table 4*).

### Comparison of clinical efficacy

Lastly, we investigated the clinical efficacy of hair transplantation or PRP injection in patients with androgenic alopecia. The treatment group had a total effective rate of 87.14%, which was significantly higher than that of the control group (*table 5*). Statistical analysis revealed a significant difference between the two groups (*table 5*).

## Discussion

Androgenic alopecia (AGA), also known as seborrheic alopecia or early alopecia [25], is a condition characterized by gradual hair loss on the top of the head. An epidemiological survey conducted in China indicated that the prevalence of this disease is 15.73%-19.75% in males and 2.73%-4.69% in females [26]. In patients with androgenic alopecia treated with placebo for five years, the density of hair can decrease by 26.3% [27]. Since androgenic alopecia is a progressive condition, early treatment is crucially important [28]. Treatment methods primarily involve the use of systemic drugs, topical

**Table 1.** Comparison of hair loss area scores between the two groups before and after treatment.

| Group | Number of cases | Before treatment | After treatment | p value |
|---|---|---|---|---|
| Treatment | 72 | 2.78±0.51 | 0.41±0.21 | 0.001 |
| Control | 75 | 2.69±0.47 | 1.48±0.38 | 0.039 |
| *p* value | | 0.912 | 0.019 | |

**Table 2.** Comparison of hair pulling test scores between the two groups before and after treatment.

| Group | Number of cases | Before treatment | After treatment | p value |
|---|---|---|---|---|
| Treatment | 72 | 0.894±0.47 | 0.214±0.12 | 0.031 |
| Control | 75 | 0.817±0.51 | 0.585±0.17 | 0.072 |
| p value | | 0.742 | 0.038 | |

**Table 3.** Comparison of hair regeneration scores between two groups before and after treatment.

| Group | Number of cases | Before treatment | After treatment | *p* value |
|---|---|---|---|---|
| Treatment | 72 | 11.874±1.63 | 3.985±0.56 | 0.0001 |
| Control | 75 | 11.537±1.58 | 6.857±0.84 | 0.001 |
| *p* value | | 0.824 | 0.025 | |

**Table 4.** Comparison of total lesion area between two groups before and after treatment.

| Group | Number of cases | Before treatment | After treatment | *p* value |
|---|---|---|---|---|
| Treatment | 72 | 15.325±3.87 | 5.031±1.01 | 0.000 |
| Control | 75 | 15.975±3.14 | 8.452±0.97 | 0.000 |
| *p* value | | 0.802 | 0.012 | |

**Table 5.** Comparison of clinical efficacy between the two groups.

| Group | Number of cases | Full recovery | Significant effect | Effective response | Ineffective response | Total effective rate |
|---|---|---|---|---|---|---|
| Treatment | 72 | 12 | 26 | 25 | 9 | 0.875% |
| Control | 75 | 7 | 12 | 10 | 46 | 0.613% |
| *p* value | | | | | | 0.002 |

medications, and hair transplantation. Combining these approaches has shown promising results [29]. In our study, we observed a reduction in the area of hair loss in both treatment groups compared to before treatment. Notably, the treatment group exhibited a significantly smaller area of hair loss compared to the control group. In this study, however, 147 patients with androgenic alopecia were investigated, and future studies should be conducted on more cases using multicentre research data.

Androgenic alopecia is a chromosomal dominant genetic disease that is dependent on androgens [30]. Patients with this condition experience a gradual decrease in hair density, accompanied by symptoms such as greasy scalp, increased dandruff, and itching. These features not only affect appearance, but also have an impact on mental health and social life [31]. The commonly used drugs for treating androgenic alopecia currently are finasteride and minoxidil [31]. While these medications have shown therapeutic effects, they can potentially affect the sexual function of patients and lead to adverse reactions, such as hirsutism and allergies. Consequently, they may not be suitable for female patients [32]. Hair transplantation can effectively improve the appearance of individuals with androgenic alopecia, but the treatment cost is high. PRP is a highly concentrated platelet solution known for its ability to promote tissue repair. It has been widely used in the treatment of ulcers, wounds, and fracture healing [33]. Its ability to promote tissue repair has been recognized in clinical practice for many years [33]. Recent studies have revealed that PRP is rich in vascular endothelial growth factor and platelet-derived growth factor, which can stimulate hair growth and hair follicle development [34]. Therefore, in this study, we aimed to investigate the efficacy of PRP treatment in reducing the severity of androgenic alopecia. After treatment, the scores of the hair pulling test in both groups were lower than those observed before treatment. Notably, the treatment group exhibited significantly lower scores on the hair pulling test compared to the control group.

PRP is a highly concentrated platelet solution that contains a variety of growth factors [35]. It has the ability to stimulate cell proliferation and differentiation [36]. PRP has been increasingly used in tissue repair in various fields including plastic surgery, orthopaedics, otolaryngology, neurosurgery, and others [37]. Similarly, our findings revealed that, post-treatment, both groups exhibited lower hair regeneration scores compared to before treatment. Significantly, the treatment group had a lower hair regeneration score than the control group.

In recent years, the emergence and advancement of hair transplantation have led to an increasing number of patients with cicatricial alopecia opting for autologous hair transplantation [38]. However, there are certain limitations to the application of hair transplantation in patients with cicatricial alopecia [39]. Firstly, patients with large-scale cicatricial alopecia

often suffer from a poor blood supply in the central area and insufficient donor hair in the recipient area. Therefore, it is necessary to combine other surgical methods, such as scalp partial excision and skin soft tissue expansion [40]. Satisfactory aesthetic results can only be achieved through multiple staged operations. Secondly, determining the optimal timing for hair transplantation for primary cicatricial alopecia is challenging. Multiple scalp biopsies are required to assess disease remission [41]. Surgical treatment is considered when the disease is stable, keeping in mind the possibility of disease recurrence following the procedure [42]. Thus, it is crucial to discuss these possibilities fully with the patients, emphasizing the necessity of immediate drug treatment and long-term follow-up care [32]. Studies have reported a lower survival rate of hair follicles (70% ~ 80%) in cicatricial alopecia compared to non-cicatricial alopecia (90% ~ 95%) following hair transplantation [41]. In recent years, various techniques have been developed to improve the prognosis of cicatricial or non-cicatricial alopecia, including combining hair transplantation with non-exfoliative dot matrix laser, micro fat transplantation, hyperbaric oxygen therapy, PRP injection, and other methods [43]. Our study demonstrated that the total area of skin lesions decreased after treatment in both groups. Furthermore, the treatment group showed a significantly smaller total area of skin lesions compared to the control group. The treatment group also exhibited a significantly higher total effective rate (87.14%) than the control group. These findings indicate a statistically significant difference between the two groups.

## Conclusion

Our study suggests that hair transplantation combined with PRP is more effective than hair transplantation alone for the treatment of androgenic alopecia, revealing the potential of this approach in clinical practice.

***Ethics approval and consent to participate:*** *all patients were informed and signed informed consent voluntarily. This study was approved by the ethics committee of the The Second Affiliated Hospital of Anhui Medical University and complied with the guidelines outlined in the declaration of Helsinki. Written consent was received from all participants.*

***Consent for publication:*** *not applicable.*

***Availability of data and material:*** *the datasets used and/or analysed during the current study are available from the corresponding author on reasonable request.*

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