

## ORIGINAL ARTICLE

# Clinical observation and evaluation of CGF in the treatment of androgenic alopecia

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## Abstract

**Purpose:** To evaluate the efficacy of concentrated growth factor (CGF) injections in patients with androgenic alopecia.

**Methods:** Venous blood of 60 patients (aged 18–55 years old with a mean age of 38 years) with androgenic alopecia who were treated from September 2017 to September 2019 were collected to prepare CGF. 0.1 ml CGF was injected into the alopecia area with an interval of 30–35 days for a total of 6 times. The evaluation was performed before treatment and at 1, 3, and 6 months after the first injection and 3 and 6 months after the last injection.

**Results:** Among the 60 patients, 58 cases received 6 treatments completely, 52 cases showed significant improvement, 8 cases improved, and no ineffective or worsening cases were found. Among the 58 patients, hair density, hair follicle density, and hair diameter increased significantly. Furthermore, the hair status of all patients was improved to varying degrees during the 6-month follow-up from the digital photographs. No complications such as redness, swelling, infection, and ulceration were found in the injection area, and the patient satisfaction was 93% (56/60).

**Conclusion:** Concentrated growth factor treatment can significantly improve the symptoms of hair loss and increase hair diameter in patients with androgenic alopecia. It is effective, safe, and worth popularizing.

## KEYWORDS

androgenic alopecia, CGF, hair growth

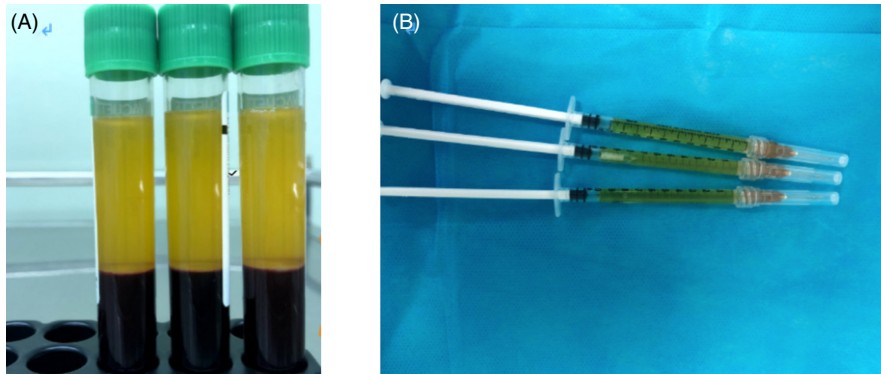
## 1 | INTRODUCTION

Hair problems can significantly alter the physical appearance and image of a person. Hair is a sexual characteristic that can be openly displayed. Long thick hair is a symbol of beauty and femininity for women, and men with thick black hair, can look young and energetic. An increasing number of people suffer from hair loss, and the incidence among adolescents has gradually increased. Although hair loss does not affect an individual's health, it has an impact on patients' self-esteem and the quality of life.

Androgenic alopecia (AGA) is the most common hair loss disorder, affecting about 50% of adults.<sup>1</sup> With the development of the economy and the continuous improvement of people's living

standards, AGA patients have higher expectations for the treatment of hair loss-related diseases. Most of the existing methods for the treatment of alopecia are drugs represented by Finasteride and Minoxidil, which are difficult for patients to take continuously, and the side effects are inevitable like drug dependence. Hair transplantation is a cosmetic repair method after hair loss treatment and has become the mainstay of hair restoration; however, it cannot fundamentally treat alopecia.

Because of the limited effectiveness of current treatments for hair loss, further studies have worked on new treatments or improved existing ones. Injection therapy employing local scalp intradermal injection of the substance contains nutrients. Compared with drugs and hair transplantation, it has the advantages of low



**FIGURE 1** (A) Blood in the test tube was stratified after centrifugation (B) the extracted CGF

invasiveness, convenient operation, short treatment time, and can minimize the risk of drug addiction and side effects. It is reasonable to believe that alopecia is a chronic disease that is difficult to heal. While after injection of platelet-rich plasma (PRP), PRP can bring a variety of growth factors to stimulate tissue regeneration.<sup>2</sup> In terms of plastic surgery, PRP has been used to improve hair loss and achieved certain results.<sup>3</sup>

Concentrated growth factor (CGF), as the third generation of platelet derivatives, is mainly composed of rich platelets, white blood cells, peripheral blood stem cells, high concentrations of various growth factors, and a fibrous reticular scaffold formed by fibrinogen, which has a strong repair function. Growth factors in CGF initiate signal cascade amplification and cause a variety of intracellular biochemical changes by binding to the corresponding receptors. The special reticular structure of CGF can effectively hold platelets and a variety of circulating molecules and delay the release of various components. With the degradation of the fibrin scaffold, the platelets decompose gradually, and the growth factor is slowly released into the local microenvironment.<sup>4</sup>

According to the characteristics of CGF, including the fact that CGF comes from patients' themselves, there is no risk of immune rejection, transmitted diseases, and risk of embolism. Therefore, CGF treatment of alopecia could be a good clinical treatment exploration direction in the future and has important academic value.

## 2 | PATIENTS AND METHODS

### 2.1 | Patients

From September 2017 to September 2019, 60 patients (aged between 18 and 55, with a mean age of 38 years old) including 37 males and 23 females with androgenic alopecia applied CGF treatment in order to observe the effect of CGF scalp injection on promoting hair growth.

Inclusion criteria included (1) patients with hair improvement needs; (2) visible hair follicles or vellus hairs in the hair loss area; (3) the diameter and the hair density of the frontoparietal hair is significantly smaller than that of the occipital hair by 20% or more; (4) men of II-VI type of Hamilton-Norwood standard and women of I-III type of Ledwig standard; and (5) patients with good compliance.

Exclusion criteria included (1) recently received hair dyes or hair perm; (2) female who is pregnant or planning pregnancy during the trial; (3) severe systemic diseases or major organ dysfunction; and (4) taking drugs such as corticosteroids that may interfere hair growth.

### 2.2 | Preparation of CGF

The venous blood was collected into a 9 ml anticoagulant vacuum tube and put into the centrifuge (Medifuge, Silfradenst srl), Preset 4°C conditions, the centrifugation procedure was set as follows: accelerate 30 s, 2700 rpm for 2 min, 2400 rpm for 4 min, 2700 rpm for 4 min, 3300 rpm for 3 min, and finally decelerate for 36 s.

After centrifugation, the blood in the tube was divided into three layers: red blood cells are deposited at the bottom, CGF is in the middle layer, and the top layer is plasma. Take 2 ml liquid from the middle layer (Figure 1). The results of flow cytometry showed that the CD34+ content of CGF obtained after centrifugation was about 10 times higher than that of normal blood.

### 2.3 | Preoperative preparation

Patient photographs were taken from the following angles: front, left and right oblique position and top of the head. Use the CBS-607 electronic dermatoscope to detect the hair condition, measure the hair number and hair follicle number in 1 square centimeter with the intersection of the binaural line and the top of the head as the center, and use a digital micrometer to measure the hair diameter, and then record relevant data. 4–6 tubes of 10 ml venous blood were collected from each patient, taking 2.0 ml CGF from each tube.

### 2.4 | Operation method

The supraorbital nerves, the auriculotemporal nerves, and the greater occipital nerves were taken as anesthesia block points. Disinfect the pre-designed anesthesia point with 75% alcohol. A

TABLE 1 Clinical efficacy

Cases	Significantly effective	Improved	Ineffective	Deterioration	Effective rate (%)
58	31	26	1	0	98.28

TABLE 2 Evaluation of hair follicle density, hair density, and hair diameter before and after treatment (\*means  $p < 0.05$ )

	Cases	Hair follicle density (/cm <sup>2</sup> )	Hair density (/cm <sup>2</sup> )	Hair diameter(μm)
Pre-operation	58	45.00 [39.00, 65.25]	72.00 [49.00, 97.00]	51.50 [43.00, 67.00]
1 month after the first injection	58	60.50 [50.00, 73.00]*	102.00 [72.00, 113.00]*	56.50 [49.00, 71.25]*
3 months after the first injection	58	65.00 [56.25, 78.25]*	118.50 [83.00, 131.00]*	62.00 [58.00, 75.00]*
6 months after the first injection	58	67.00 [59.00, 80.00]*	122.50 [89.50, 135.00]*	65.00 [60.00, 77.00]*
3 months after the last injection	58	67.00 [59.00, 81.25]	123.00 [90.00, 140.00]	66.00 [61.00, 77.00]
6 months after the last injection	58	67.00 [59.00, 82.00]	123.50 [92.75, 142.50]	66.00 [62.75, 77.25]

TABLE 3 Comparison of hair follicle density, hair density, and hair diameter before surgery and 6 months after the first injection

	Hair follicle density (/cm <sup>2</sup> )	Hair density (/cm <sup>2</sup> )	Hair diameter (μm)
Pre-operation	45.00 [39.00, 65.25]	72.00 [49.00, 97.00]	51.50 [43.00, 67.00]
6 months after the first injection	67.00 [59.00, 80.00]	122.50 [89.50, 135.00]	65.00 [60.00, 77.00]
Statistic	5.37	5.79	5.51
<i>p</i> value	<0.05	<0.05	<0.05

total of 1 ml of 0.75% lidocaine mixed with 1:200,000 epinephrine were injected into each point, with a total amount of 6 ml. The operation area was designed according to the area of alopecia. After a successful anesthesia block, the patient was placed in the supine position, sterilized the patient's head with 75% alcohol, spread the aseptic operation sheet, 0.1 ml CGF was injected every 1 cm, and the injection depth was under the cap aponeurosis. After the injection, erythromycin ointment was applied to the pinhole. Patients were forbidden to wash their hair within 24 h. Once a month, 6 times in total, followed up to 6 months after the last operation.

## 2.5 | Effect evaluation

The evaluation was performed before treatment and at 1, 3, and 6 months after the first injection, and at 3 and 6 months after the last injection. We used a digital micrometer to measure the change in hair diameter. The changes in hair follicle density and hair density were observed and counted under a hair microscope. Each time was counted by the same plastic surgeon who did not participate in the operation. We use four categories to evaluate treatment effects including significant improvement, improvement, ineffective, and deterioration. Significant improvement criteria: hair density increased by 50% or more, and hair diameter increased by 20% or more. Ineffective is that the hair density increased by 0–19% and the hair diameter increased by 0–10%. Deterioration is no increase or negative growth of hair density and hair diameter. Other conditions were considered as improvement.

## 2.6 | Statistical processing

The measurement data in this study that do not conform to the normal distributions were presented in median and quartile range. The evaluation data were hair density, hair follicle density, and hair diameter before the operation, at 1, 3, and 6 months after the first injection, and at 3 and 6 months after the last injection. All the values were tested by a nonparametric test.  $p < 0.05$  was considered to indicate a statistically significant difference.

## 2.7 | Satisfaction evaluation

58 out of 60 patients completed the follow-up. At the 6 months after the last injection, questionnaires were distributed to the patients for subjective evaluation, and the hair loss improvement effect was assessed compared with pre-operation. There are five grades: very satisfied, satisfied, average, unsatisfied, and very unsatisfied.

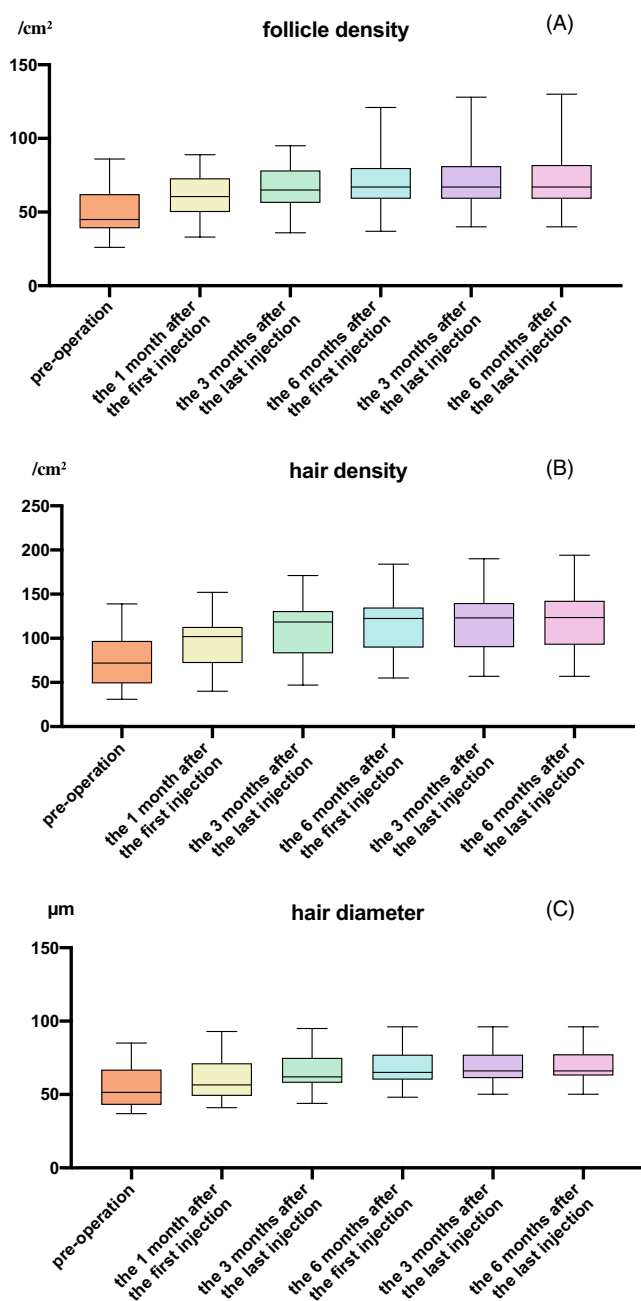
## 3 | RESULTS

Among the 60 patients, 58 cases were treated 6 times, 31 cases were significantly effective, 26 cases were improved, 1 case was ineffective, and there was no deterioration. The total effective rate was 98.28%, as shown in Table 1.

After 6 months of follow-up, it was found that all the patients' hair conditions had improved to varying degrees and the scalp

**TABLE 4** Comparison of the average growth rate of hair follicle density, hair density, and hair diameter after treatment compared with before surgery

	Cases	The average growth rate of hair follicle density (%)	The average growth rate of hair density (%)	The average growth rate of hair diameter (%)
1 month after the first injection	58	34.44	41.66	9.71
3 months after the first injection	58	44.44	64.58	20.59
6 months after the first injection	58	48.89	70.14	26.21
3 months after the last injection	58	48.89	70.83	28.16
6 months after the last injection	58	48.89	71.52	28.16



**FIGURE 2** Box diagram of hair follicle density, hair density, and hair diameter (A–C)

of the patient was healthy pink. Among the 58 patients, the hair density increased by 70.14% compared with preoperative, and 6 months after the first injection, the hair follicle density increased by 48.89%, and the hair diameter increased by 26.21%. The evaluation of hair follicle density, hair density, and hair diameter before and after treatment is shown in Table 2. The comparison of hair follicle density, hair density, and hair diameter preoperative and at 6 months after the first injection is shown in Table 3, and the average growth rate of hair follicle density, hair density, and hair diameter after treatment was shown in Table 4. There were no swelling, infection, or ulcer complications at the injection site. Erythema and macular inflammation occurred in the scalp of 27 patients, of which 18 cases of macular and erythema were relieved and the inflammation improved.

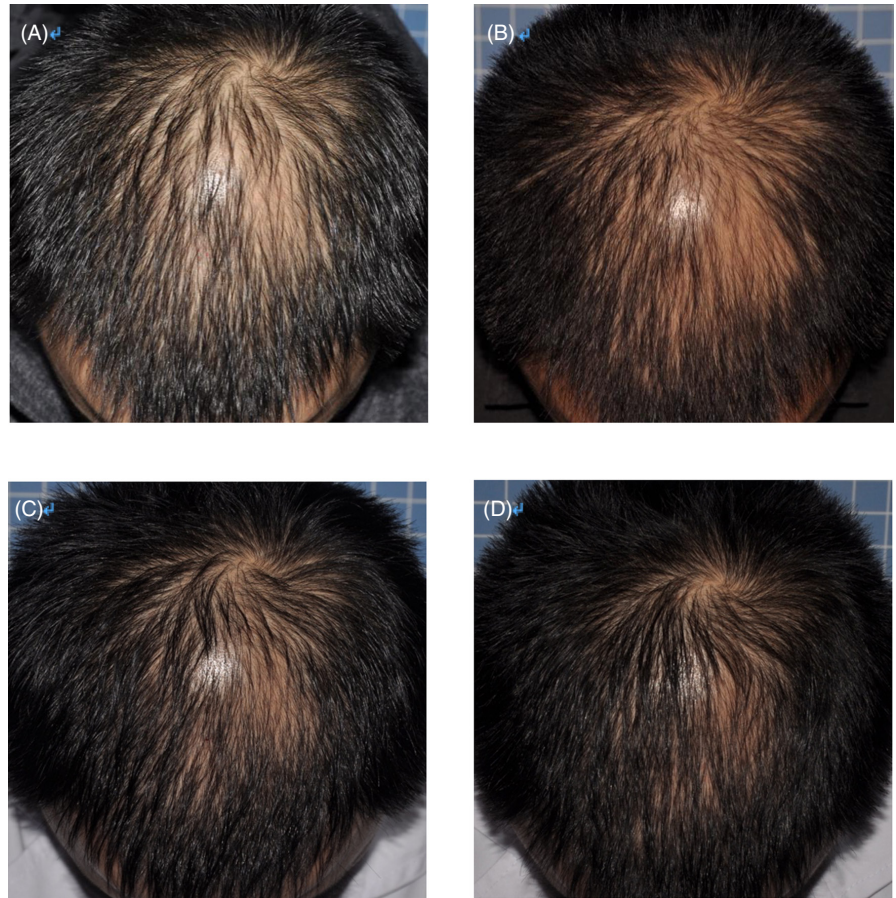
According to Table 3, it can be found that 6 months after the last treatment, the growth rate of hair follicles is slower than that of hairs, which indicates that the number of 2 or 3 hairs growing in a single hair follicle is increasing.

According to Tables 2 and 4, the hair density changed the most, almost doubling from the initial 72 to 123.50. 1 month after the first injection, with obvious effect and an average growth rate of 31.33%. At 3 months after the first injection, the average growth rate reached 64.58%, and at 6 months after the first treatment, the average growth rate was 70.14%, and the hair density was 122.50. From then on to 6 months after the last injection, the overall change range was not large, which indicated that 6 months after the first injection can achieve good results.

Table 2 shows that the density of hair follicles has increased from 45 before surgery to 60.05 1 month after the first injection, with an average growth rate of 34.44%. 6 months after the first injection, the density of hair follicles reached 67.00, with an average growth rate of 48.89%. The diameters of hair before the operation, at 1, 3, and 6 months after the first injection were 51.5 μm, 56.50 μm, 62.00 μm, and 65.00 μm, respectively. There was little change during the 6 months follow-up, indicating that the growth rate was relatively uniform and slowly increasing. Hair density and hair diameter have achieved good results 6 months after the first injection, and the effect has stabilized after 3 months of follow-up.

It can be seen from Table 3 that the hair density, hair follicle density, and hair diameter increased significantly before the operation

**FIGURE 3** Photograph of male patient (A) before surgery (B) 1 month after the first injection (C) 3 months after the first injection (D) 6 months after the last injection



and 6 months after the first injection,  $p < 0.05$ . The difference was statistically significant.

As shown in Figure 2A-C are the box diagrams of hair follicle density, hair density, and hair diameter, respectively. It can be found that with the increase in the number of treatments, a good upward trend can be achieved 3 months after the first treatment, the dispersion degree tends to be stable 6 months after the first treatment, and the results are stable after 6 months of follow-up.

The overall hair status of the patient before operation, at 1 and 3 months after the first injection, and at 6 months after the last injection is shown in Figures 3 and 4. The subjective evaluation of the patients at 1, 3, and 6 months after the first injection showed that the hair follicle density was ineffective-effective-cured, the hair density was effective-effective-cured, and the hair diameter was effective-cured-cured. Patient satisfaction was reported by 97% (56 of 58). The other 2 people thought that the hair coverage rate was still low and the scalp exposure was obvious. This may be related to the fact that the patient's hair is too sparse before the operation, so it is recommended that the patient be treated with a hair transplant.

No complications such as redness, swelling, infection, or ulcer were found in the injection area. There were inflammatory phenomena including red spot and macula in the scalp of 28 patients before operation, among which the macula and red spot decreased in 18 patients after operation. Scalp inflammation improved. Before surgery, 6 patients had more white hair on both sideburns and top of head than patients in the same year, and the proportion of black hair

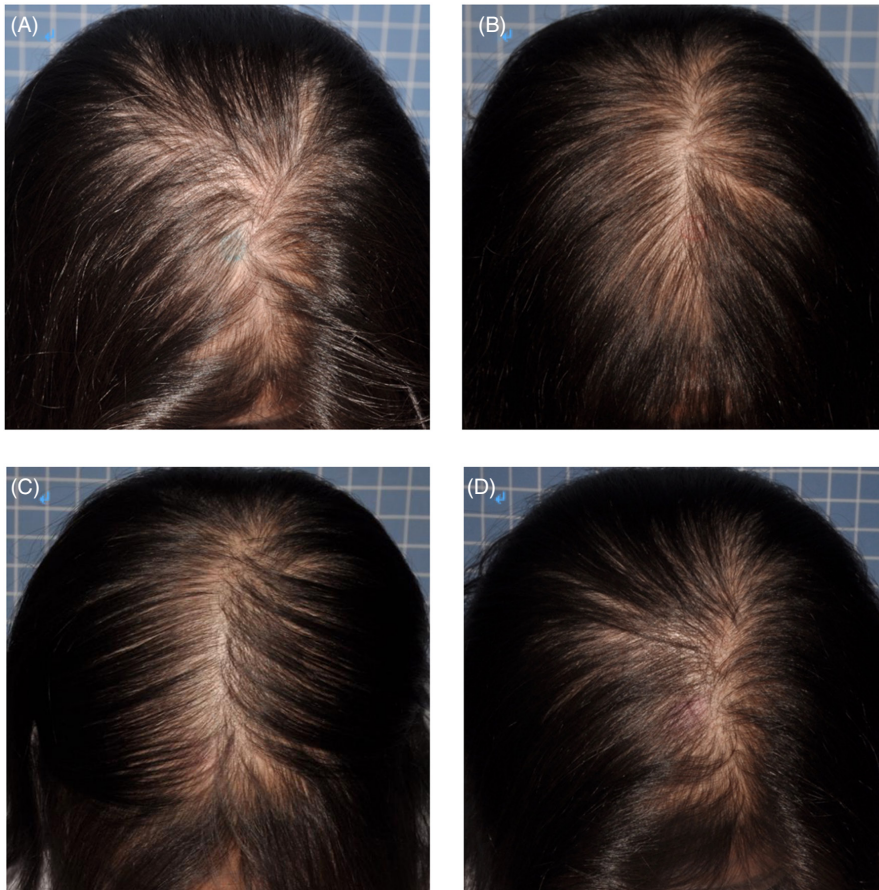
decreased. Among them, 3 patients reported that the phenomenon was alleviated, the proportion of black hair increased and white hair decreased after operation.

Overall, 24 patients were very satisfied, 32 were satisfied, 2 patients chose neutral, and no one indicated unsatisfied and very unsatisfied. The statistical results are shown in Figure 5. The overall satisfaction (very satisfied and satisfied) rate was 96.6% (56/58), and the overall dissatisfaction (average, unsatisfied, and very unsatisfied) rate was 3.4% (2/58).

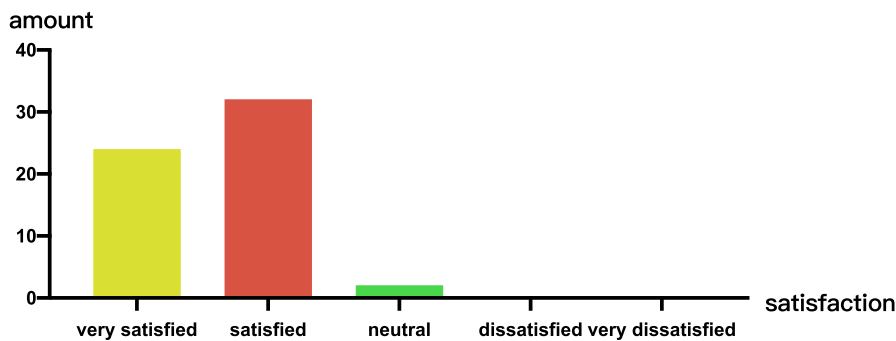
## 4 | DISCUSSION

Hair loss has become one of the important diseases affecting people's physical and mental health. Many patients with sparse hair, exposed scalp, and hairline retreat, so that the whole person looks much older than their peers, thus losing self-confidence and under great psychological pressure.<sup>5</sup>

The treatment of hair loss, like the fight against human aging, is a slow and long-term process. There are many non-surgical methods that can delay the process of hair loss. Such as regular shampoo, make the scalp clean and avoid greasy, and provide a more comfortable environment for hair follicles. Patients can also massage the head with warm water to strengthen the blood circulation of hair follicles and enhance the nutritional supply of hair follicles. Choose a shampoo that is more suitable for patients,<sup>6</sup> and proper vitamin



**FIGURE 4** Photograph of female patient (A) before surgery (B) 1 month after the first injection (C) 3 months after the first injection (D) 6 months after the last injection



**FIGURE 5** Satisfaction survey

supplements are also beneficial to hair growth.<sup>7</sup> Some ingredients of Chinese medicine can also condition the body and scalp. At the same time, ensuring enough sleep, reducing work pressure, and keeping a good mood can also be very important.

In the treatment of hair loss drugs, minoxidil can open potassium channels, transport nutrients for DPC, restore hair follicle vitality, and promote hair follicle growth. Finasteride tablets can reduce DHT in the blood, thereby preventing hair loss. However, drugs still possess issues of dependence, withdrawal symptoms, and side effects. Hair transplantation is an effective way to achieve a better appearance, but it can only be used as an appearance repair method after drugs or other treatments, and is not suitable for patients in the hair loss period.

Injection therapy is a method of locally applying drugs to the skin. Compared with other treatments, injection therapy has the advantages of less invasiveness and high safety factor, and can

minimize the risk of side effects. As a means of injection treatment of alopecia, PRP has been written into the guidelines for the diagnosis and treatment of androgenic alopecia in China, and the effect is definite. CGF is called the third generation PRP, which is rich in softer and thinner organic fibrin grid and a high concentration of growth factors, which is more conducive to tissue regeneration and repair.<sup>8</sup> The growth factor content in CGF and adhesion and stretch of fibrin are better than those in PRP.<sup>9</sup> Steward et al.<sup>10</sup> found that PRP combined with microneedles and CGF gel can improve microcirculation and promote hair growth in 20 patients. Tan et al.<sup>11</sup> found that when one side of the scalp was injected with CGF, the other side was injected with placebo, and minoxidil was used 3 months after injection, it was observed that the hair density and hair growth rate of CGF injection side were significantly higher than those of minoxidil group alone, which indicated that

CGF combined with minoxidil might be better in the treatment of alopecia.

As the third-generation autologous blood extract, CGF has obvious advantages. The advantages of CGF in the treatment of hair loss conclude ideal hair growth promotion effect, increased scalp coverage, and overall hair thickening without obvious side effects. Besides, CGF is self-derived, fundamentally avoiding the trouble of immune rejection and the spread of diseases. CGF injection is simple, rapid, and easy to master and operate. It can be prepared and injected at the same time in the treatment, reducing the possibility of intermediate links and pollution, and effectively reducing medical costs.

However, there is still a lack of unified indicators to judge hair growth. In our experiment, one square centimeter of the center of the binaural line on the top of the skull is taken as the counting range, but this cannot guarantee that it will be in the same position every time. In addition, as for the detection of hair diameter, because the hair is randomly selected every time, there may not be a stable growth value, so the objective and the unified standard are still something we need to solve.

## 5 | CONCLUSION

At present, there are many patients suffering from hair loss all over the world. However, due to the inertia of the patient group, it is difficult to take long-term medicine or undergo a single operation for too long, and the treatment of hair loss takes years.

Whether medicine or surgery requires a waiting period of half a year to 1 year. It is difficult for patients to agree. It is precisely because the current treatment of hair loss on the market has the above drawbacks that some patients choose wigs, shadow powder<sup>12</sup> and other methods to replace and thus give up the treatment of hair loss. CGF is an injection product like botulinum toxin and hyaluronic acid which can be injected conveniently and has no recovery period. It can have a good effect in 3–6 months. It can give patients greater confidence in healing and is worthy of clinical promotion. However, we should comprehensively consider many factors such as the patient's age, gender, and physical condition, and give the patient personalized treatment to achieve satisfactory results.

### CONFLICT OF INTEREST

The authors declare that they have no conflict of interest to disclose.

### DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available on request from the corresponding author. The data are not publicly available due to privacy or ethical restrictions.

### ETHICAL APPROVAL

All patients signed an informed consent form, and the study was researched in the First Affiliated Hospital of Harbin Medical University and approved by the Institutional Ethics Committee by the First Affiliated Hospital of Harbin Medical University.

### CONSENT STATEMENT

Informed consent was obtained for experimentation with human subjects. The privacy rights of human subjects were observed.

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**How to cite this article:** Zhao F, Hao L, Jin X. Clinical observation and evaluation of CGF in the treatment of androgenic alopecia. *J Cosmet Dermatol*. 2022;21:5723–5729. doi: [10.1111/jocd.15109](https://doi.org/10.1111/jocd.15109)