Innovative Method of Alopecia Treatment by Using Adipose-derived Stromal Vascular Fraction (SVF) Cells

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Short report

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Abstract

Background

Androgenetic alopecia (AGA) is characterized by progressive reduction of hair density on the scalp through gradual conversion of terminal hairs into vellus hairs. Stromal vascular fraction (SVF) cells harvested from fat cells are one of the latest breakthroughs in the aesthetic field. This study aimed to present clinical cases for the treatment of alopecia areata by transplantation of SVF into the scalp.

Objective

To evaluate the efficacy of the use of the stromal vascular fraction (SVF) in androgenetic alopecia patients.

Methods

9 patients (age range 43-64 years; 4 men, grade IV to V and 5 women, grade I to III), who are suffering from AGA, have been treated with a single injection of autologous SVF in the upper scalp. Autologous SVF was generated and characterized before the injection of 7-8 × 10^6 cells into the scalp of the patient. Hair regeneration was assessed by three clinical tests: hair skin quality, hair thickness, and hair density at 3 and 6 months post-injection and compared to pre-injection results.

Results

Hair density was significantly increased after 3 and 6 months post injection (P = 0.01 and P=0.009). The increase in thickness was notably seen at 6 months post injection (P = 0.02). Furthermore, a significant improvement in the score of keratin of scalp was seen in the treated side as compared to the nontreated side (p=0.032). No side effects were noted after treatment.

Conclusions

A single treatment of SVF injected into the scalp of patients with AGA significantly increased hair density within 3 to 6 months. The obtained results prove the efficacy and the safety of the treatment, and satisfaction of the patients confirm the quality of the results.

Introduction

Androgenetic alopecia (AGA) is a genetically determined and androgen influenced progressive condition, which is characterized by progressive hair loss of the scalp, and its prevalence increases significantly with age[1,2]. Although AGA is hereditary, circulating androgen hormones may trigger its onset by miniaturization of hair follicles resulting in the conversion of terminal hair to vellus hair. AGA becomes a medical problem when the hair loss is subjectively considered as excessive, premature, and distressing. AGA is similar to tissue damage, and repair processes are influenced by growth factors that in turn stimulate homing of cells and chemotaxis[3,4,5].

At the cellular level, a decrease in hair follicle size is due to loss of stem cells or progenitors at the bulge region of the hair follicle. Conventional approaches for hair refurbishment include medications and hair follicle

transplantation surgery[6]. However, these strategies are mostly ineffective due to drawbacks including high cost, numerous side effects, unsatisfactory results, and the requirement for long-lasting use of medicines. In addition, their efficacy is dependent on gender. Contemporary therapies with promising results are required that should be effective in both sexes, and the outcomes should be long-lasting.

Treatment options for men and women with hair loss include medical therapy, hair transplant surgery, low-level laser therapy, hair systems, micropigmentation of the scalp, and topical concealer fibers[7,8]. These options are not without shortcomings, and thus researchers are always looking for new and alternative therapies[9]. One emerging area of clinical and scientific focus lies in exploring the role of adipose tissue (fat), and specifically autologous adipose transplantation[10], in the complex, hair growth cycle. Although platelet- rich plasma (PRP) injections are frequently used for AGA patients and overall results suggest that it has a good therapeutic effect[11], the treatment has to be repeated several times leading to poor compliance of the patient.

The repair of hair follicles in AGA could be improved using a combination of regenerative cells (i.e., stromal vascular fraction (SVF)) as a source of growth factors. Adipose tissue-derived SVF contains non cultured regenerative cells, such as mesenchymal stem cells (MSCs) or adipose derived stem cells(ADSCs), that can “home” to the site of injury[12,13,14]. Abundant research has supported the fact that adipose is biologically active, complex, and an important tissue. In the context of the scalp, adipocyte lineage cells support the stem cell niche and help drive the hair growth cycle[15]. Shin et al documented the role of ADSC-conditioned media in promoting hair growth in female pattern alopecia[16,17].

Today, autologous fat is transplanted primarily for an esthetic and reconstructive volume effect, and traditionally, rates of graft retention have been widely varied. A number of strategies have been applied to increase this rate of graft take. One such strategy is to enrich the adipose with SVF, a heterogeneous group of generally well-characterized multinucleated cells that can be reliably extracted from adipose by using automated systems. These cells work largely by paracrine mechanisms to support adipocyte viability.

SVF is applied to restore hair growth because it contains several types of regenerative cells such as MSCs that are highly proliferative, have multi-lineage differentiation potential, and are immunomodulatory and immunosuppressive[14]. Furthermore, the cells in SVF also secrete various growth factors and proteins which can perform several functions including activation of hair follicles[18]. SVF can have multiple effects on miniaturized hair follicles by homing to the hair follicles and by their paracrine effects. Stromal vascular fraction-based treatment for AGA can open a new avenue for the development of therapies for hair restoration[19].

In a group of AGA patients, SVF was injected into the affected area of scalp. After 6 months, the patients were assessed by a physician, and patient global assessment scores were recorded. Photographs of the affected areas were taken. The results show an increase in hair density, decreased hair fall, and improvement in physician and patient global assessment score after SVF treatment.

Materials & Methods

Subjects

The medical records of patients were reviewed to collect subjects treated with only SVF at the plastic surgery clinic (TOP Plastic Surgery, Seoul, Korea). A thorough medical and hair history was collected, and a physical examination was performed to diagnose male or female pattern alopecia. Patients in this clinical series were healthy men and woman aged 43–64 years with androgenic baldness rated using the Norwood–Hamilton grades and Ludwig scale. Over a period of 6 months, a total of nine subjects (4 men and 5 women) were enrolled. The investigators reviewed the inclusion and exclusion criteria (Table 1) to screen patients accordingly. Importantly, patients who reported the administration of any agent aimed at affecting hair growth within 6 months prior to presentation, regardless of whether they were prescribed by a physician or obtained over the counter, were excluded from participation. All patients had a body mass index (BMI) within normal limits. All patients were considered generally healthy, and no patients had comorbidities such as diabetes or high blood pressure. Written informed consent for the procedure, including photographing and publication in a medical and scientific journal for educational purposes, was obtained from all subjects, and the protocol was reviewed and approved by the hospital's Internal Medical Advisory Committee. Table 2 summarizes patient demographics, including the amount of adipose harvested, processed, and injected SVF.

Table 1
Inclusion and exclusion criteria for enrollment of patients in the study.

Inclusion	Male and female patients with androgenic alopecia
	Age of 43–64 years, provide written informed consent and comply with the study requirements
	Norwood-Hamilton grades II-VI or Ludwig Class I-III
	Active hair loss within last 12 months
	No clinically significant disease or abnormal laboratory results at the time of screening visit
	Patient has adequate abdominal or other subcutaneous adipose tissue accessible by syringe-based lipoharvest
	For women of child-bearing potential: negative pregnancy test at screening visit
Exclusion	Patients with inflammation, infection, malignancy, allegoric disease, autoimmune disease, pregnancy, diabetes and on current anticoagulant therapy.
	Subject who has previously failed or has been deemed nonresponsive to a previous experimental hair loss treatment, prior surgery in the treatment area and subject who has a sensitive, irritated, or abraded scalp area
	Clinically significant medical or psychiatric illness currently or within 30 days of study screening as determined by the investigator
	Any disease or condition (medical or surgical) that in the opinion of the investigator, might compromise hematologic, cardiovascular, pulmonary, renal, gastrointestinal, hepatic, or central nervous system function; or any condition that would place the subject at increased risk

Table 2
Patient profile before SVF injection.

Patient's No.	Age	Gender, M/F	Stage	Aspirated adipose tissue/cc	Total SVF cells/cc	Injected live cells/spot
1	51	M	Class IV	70.2	295,056	198,971
2	51		Class IV	90	661,111	160,000
3	54		Class V	80	306,000	160,000
4	56		Class V	90	302,222	160,000
5	43	F	Class II	90	310656	160,000
6	44		Class II	90	501,500	160,000
7	48		Class I	90	436,050	160,000
8	59		Class II	80	554,625	160,000
9	64		Class III	90	737,778	160,000

Liposuction, Harvesting, and Preparation of Adipose Tissue Processing

On the day of surgery, specific surgical goals were reviewed with patients regarding lipoaspiration and scalp injection of adipose enriched with adipose-derived stem cells (ADSCs – also known as SVF) to address their alopecia. Under either general anesthesia or twilight anesthesia, tumescent fluid (500 mL of Ringer's lactate [RL] with 20 mL of 1% lidocaine and 1 mg of epinephrine) was infiltrated, and fat tissue was harvested with a 60 mL Luer Lock syringe from the abdominal subcutaneous layer by using a 3.0 mm cannula (Medical land, Seoul, Korea). An average volume of 90 mL of adipose was harvested from patients. The lipoaspirate was divided into two aliquots.

The HuriCell System (HC1500, HurimBioCell, Seoul, Korea) was used to obtain SVF according to the manufacturer's instructions. In general, tissue processing within the HuriCell device uses a single-use sterile disposable set and the HuriCell reagents (HRR) processing enzyme reagent (Sigma-Aldrich Corp., Seoul. Korea). Once the HuriCell disposable kit is placed within the device, the system performs an auto-check to ensure the integrity of the closed system. Tissue is then introduced into the processing canister where it is weighed and then washed with the saline solution to remove the residual waste solution and extravasated blood. The HuriCell device calculates the amount of HRR reagent to be used (based on tissue weight) and then, at the appropriate stage, prompts the operator to add the required volume of HRR. The tissue is continuously agitated during enzymatic digestion of the connective tissue. Once digestion is complete, the SVF fraction is

pumped into a centrifuge chamber where it is washed and concentrated. The final cell product can then be aspirated from the chamber in a volume of 13 mL.

The stromal cell fraction was filtered through a 70 μm cell strainer (BD Biosciences, Inc., San Jose, CA, USA). The number and relative viability of SVF recovered from tissue processing samples in each study were determined using a Semiautomated Cell Counter (ADAM MC Cell Counter; NanoEnTek, Seoul, Korea).

Phenotyping SVF

Expression of surface markers on SVFs was determined by AttuneTM NxT Flow Cytometer (Thermo Fischer Scientific). SVF was stained for the surface expression of CD31, CD34, CD45, CD73, CD90, and CD105 using each specific anti-human antibody (BD Pharmingen, CA) for flow cytometric analysis. Isotype control staining was performed with IgG1-FITC and IgG2b-PE. Data represents the percentage of positive cells for each marker analyzed on SVFs and are means ± SD.

Treatment and Evaluation of AGA

The SVF was injected into the scalp of the patient according to the following procedure: (1) the upper frontal, biparietal, and upper pyramidal area were first treated with the aseptic chlorhexidine without local anesthesia; (2) to reach the hair follicle area, the injection into the scalp area was performed with the following attributes: 3cc syringe; gauge, 30; and depth, 4 mm ; (3) 0.15 ml per injection was delivered perpendicularly, separated by 2 cm in a square shape all over the scalp marked previously; a total of 4 ml were injected in 48 spots; (4) after the injection was administered, the needle was kept in the scalp for 2 s. After the transplantation, the patient was prescribed nonsteroid anti-inflammatory and cephalexin antibiotics for 3 days. Patients were advised not to shower until 24 h after the procedure, not to sunbathe until after 1 week, and not to engage in sports until after 1 week; however, return to work can be on the same day. Follow-up for hair evaluation was based on the hair cycles and was performed 1, 3 and 6 months after injection, using Aroma Smart Wizard system (ASW200, Aram Huvis, Seoul, Korea).

Measurements and statistical analysis

Hair density (hair count per cm^2) was calculated by counting the total number of hairs in the target area. Hair thickness was calculated as the average diameter of hairs, and scalp status, keratin of scalp, scalp sensitivity, scalp sebum, hair pore status, and cuticle status measured automatically on the Smart Wizard System. Mean differences were then tested by paired t-tests. It should be noted that the sample size decreases over time, so less weight should be given to observed differences at time points. Wilcoxon signed rank tests were applied to detect the difference in the rates between different groups. P values of less than 0.05 were considered significant.

Results

In the current study, patients enrolled were divided into two groups: Male group (n = 4) and female group (n = 5). Given that current clinical practice guidelines on the treatment of AGA, we treated finasteride 1 mg, dutasteride 0.5 mg for men and 3% minoxidil foam for women.

First, based on a joint statement of the International Federation for Adipose Therapeutics and Science (IFATS) and the International Society for Cellular Therapy (ISCT) published in 2013, which point out the minimal phenotypic criteria to characterize the uncultured SVF population from adipose tissue, these freshly isolated cells were characterized (Table 3). The immunophenotyping of the transplanted cells showed a clearly heterogeneous population expressing not only the mesenchymal stem cell markers but also the panhematopoietic/monocyte/macrophage/endothelial/pericyte markers along with particularly high levels of CD34[19].

Table 3
Immunophenotyping of cell surface markers expressed by total nucleated SVF cells

Marker	Percentage of gated (Means ± SD, n = 9)	Characterization
CD31	33.88 ± 11.45	Endothelial
CD34	55.65 ± 11.85	Hematopoetic
CD45	2.33 ± 2.06	Immunological
CD73	12.53 ± 13.39	Mesenchymal
CD90	58.52 ± 11.19	Mesenchymal
CD105	10.03 ± 8.44	Mesenchymal
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Table 4
Comparison of hair density before (pre-injection), and at 1, 3 and 6 months (postoperative) after SVF treatment.

Patient's initials	Age, yrs	Gender, M/F	Density preoperatively (hair/cm^2)		Density 1month postoperatively (hair/cm^2)		Density 3months postoperatively (hair/cm^2)		Density 6months postoperatively (hair/cm^2)	
			Non-Treated	Treat	Non-Treated	Treat	Non-Treated	Treat	Non-Treated	Treat
1	51	M	40	50	40	50	55	75	65	90
2	51		30	40	45	50	50	65	65	80
3	54		25	30	40	55	45	75	55	90
4	56		50	45	60	50	60	55	70	85
5	43	F	40	45	40	45	45	70	60	100
6	44		60	55	70	65	75	85	85	95
7	48		55	55	55	60	60	75	70	95
8	59		30	30	35	45	45	65	75	80
9	64		70	40	70	45	55	85	75	95

Table 5
Comparison of hair diameter before (pre-injection), and at 1, 3 and 6 months(postoperative) after SVF treatment.

Patient's initials	Age, yrs	Gender, M/F	Thickness preoperatively (mm)		Thickness 1month postoperatively (mm)		Thickness 3month postoperatively (mm)		Thickness 6month postoperatively (mm)	
			Non-Treated	Treat	Non-Treated	Treat	Non-Treated	Treat	Non-Treated	Treat
1	51	M	0.022	0.028	0.028	0.031	0.044	0.042	0.047	0.055
2	51		0.028	0.023	0.03	0.023	0.033	0.029	0.047	0.045
3	54		0.018	0.021	0.028	0.029	0.032	0.031	0.049	0.051
4	56		0.029	0.027	0.03	0.033	0.022	0.044	0.033	0.047
5	43	F	0.034	0.028	0.03	0.031	0.04	0.046	0.06	0.063
6	44		0.033	0.035	0.037	0.036	0.038	0.038	0.053	0.056
7	48		0.034	0.025	0.036	0.038	0.048	0.052	0.066	0.082
8	59		0.029	0.038	0.038	0.046	0.04	0.048	0.062	0.063
9	64		0.06	0.038	0.06	0.04	0.061	0.065	0.063	0.068

Patients in each group underwent transplantation of SVF according to individual hair loss type. The mean age of patients was 53 ± 1.22 in male group and 51.5 ± 3.43 in female group. A total of 3 (30%) patients had a family history of AGA, while the 6 remaining patients (70%) had no AGA history but were experiencing active hair loss within the last 12 months. One female (20%) exhibited Ludwig scale type III and 3 females (60%) had Ludwig scale II. Among male patients, most of them were with Hamilton-Norwood scale type IV or V. No side effects were observed in any enrolled patient.

The images were taken from the same affected area of the scalp at each visit in both groups, and the number of hair/cm^2 was counted in each patient. In addition, in one subject, half of the affected area of the scalp was treated with SVF, while the other half was not treated. Mean density of hair on the pre-injection visit in the nontreated site was 44.44 ± 5.09 versus 43.33 ± 3.11 in the treated site (Fig. 1). On the final visit (after 3 months of last session), it was 68.88 ± 2.97 in the nontreated site versus 90 ± 2.35 in the treated site. Overall, the percentage of density increased in the treated site by 48.11% as compared to the nontreated site density of 35.48%. Hair density was significantly increased on the treated side at 3 months after pre-injection (P = 0.01 and P = 0.009 respectively, n = 9).

Hair thickness was calculated with one average value obtained for analysis per patient. The increase in thickness was significant at 6 months post injection (P = 0.02) (Fig. 2). The average hair thickness on the pre-injection visit was 0.032 ± 0.053 mm in the designated nontreated site compared to 0.029 ± 0.003 mm in the designated treated site. On the 6 months post-injection visit, hair thickness was 0.053 ± 0.003 mm in the nontreated site compared to 0.058 ± 0.003 mm in the treated site.

The treated areas did not show any overall significant changes in scalp status, scalp sensitivity, scalp sebum, hair pore status, cuticle status, or any of the other parameters measured with skin analysis throughout the 6 months follow up except keratin of scalp (Fig. 3). Although the majority of the patients do not achieve improved scores, a significant improvement in the score of keratin of scalp was seen in the treated side as compared to the nontreated side ($p = 0.032$). Representative global and macrophotographs of a patient at 6 months are shown in Fig. 4.

Discussion

In this study, we investigated the potential effect of the adipose-derived stromal vascular fraction (SVF) on androgenetic alopecia (AGA). Adipose tissue being a biologically active complex is important for tissue engineering and regenerative medicine applications[14]. In the current study, we used SVF which is a mixture of several types of cells including ASCs. Tolerability and safety of using SVF was determined, and no adverse side effects were reported in any patient.

In AGA patients, the basic concept of using SVF is to replenish stem cell repository in the bulge region of hair follicles by homing and to stimulate growth cycle of stem cells by paracrine effects[17]. SVF is known to be one of the most accessible sources of MSCs and has recently emerged as a new therapeutic option for degenerative conditions.[18] With a primary role in the homeostasis of organs and tissues, MSCs maintain the stem cell niche, help tissue recovery after injuries, and ensure healthy aging[13]. In addition to replacing damaged cells in affected tissues, SVF has beneficial effects through its paracrine action via various cytokines and growth factors [18, 20]. A recent study showed the synergic effect of PRP and micrografts enriched with autologous human follicle MSCs on AGA[10,11]. In comparison with PRP or micrografts, ADSC-based therapies have more published evidence of their effect on hair regrowth through clinical trials[21].

The therapeutic role of SVF was assessed using parameters such as hair density, hair thickness, photographs, and status of scalp. In this case series, the potential effect of a single dose of SVF on AGA was tested. There was a significant increase of hair density in the treated site compared to the nontreated site. The average number of hair thickness of the treated side was significantly increased at 6 months post injection ($P < 0.05$). Furthermore, nonfunctioning hair follicles filled with hyper-keartotic plugs[22], up to today assumed incapable of forming new hair, showed more significant improvement in the score of keratin of scalp in the treated side as compared to the nontreated side ($p = 0.032$). No side effects were noted after treatment.

Currently, only a few FDA-approved agents for AGA treatment are available[22]. Finasteride and minoxidil, either as monotherapy or in combination, are recommended as the gold standard treatment for AGA[23,24]. The current clinical practice guidelines on this treatment include finasteride 1 mg, dutasteride 0.5 mg for men, and minoxidil 2% solution or minoxidil 3% foam for women. Lucky et al[25] revealed that hair density was increased by 17.3% by the application of 5% minoxidil twice per day for 48 weeks in female AGA patients. Also, 157 male patients with AGA treated with 5% topical minoxidil for 48 weeks had increased hair density and thickness by only 12.3%[26,27]. In our study, hair density was increased by 48.11%, and hair thickness was increased by 50% by one application of SVF treatment. SVF-based therapeutics allow for more options for female patients with AGA. Moreover, there is increasing evidence of the positive outcomes of ADSC treatment in combination with

human follicle stem cells in hair regrowth.[27,54,55] Although many laboratory experiments and animal studies have investigated the effects of ADSC on hair growth and identified its positive effect in promoting hair regeneration, only a few clinical trials have investigated the effects of ADSC-based therapies on the hair cycle in humans[28,29].

According to recent data, promotion of hair growth via ADSCs can be enhanced by combining it with minoxidil, which stimulates the motility of ADSCs and increases the secretion of growth factors and paracrine signaling[29]. This result might suggest that ASCs migrated close to the injection site and enabled hair growth. Alternatively, ASCs might be capable of migration by making use of the local circulation. The differentiation as well as production and secretion of growth factors that activate neighboring cells are also mentioned as relevant functions of ADSCs. Compared with healthy individuals, in patients with AGA, the expression of vascular endothelial growth factor (VEGF), keratinocyte growth factor (KGF), epidermal Growth Factor (EGF), and transforming growth factor-β1 (TGF-β1) is disturbed in the hair follicles, and this affects the hair cycle differently depending on the age and sex[30]. Therefore, it is clinically important to personalize the optimal concentration, dosage, and frequency of adipose derived stem cell (ADSC)-based therapies. Indeed, clinical trials have shown that the efficacy of ADSC-based therapies in AGA treatment is dependent of a number of different variables, such as the type of formulation, presence of combined treatments, and delivery methods of ADSC-based therapies[22,31,33].

The proposed strategy can provide not only a treatment for AGA patients but also be helpful in the development and success of tissue engineering and regenerative medicine applications. In addition, the results of this study will open a new avenue in dermatology for the treatment of patients with AGA. Taking everything into consideration, we believe that the hallmarks of tissue damage are also present in AGA. Addressing the combination of both cellular as well as intercellular aspects of wound repair as an alternative treatment of AGA seems to deserve further attention.

Conclusions

This initial data experience demonstrates that scalp stem cell-enriched grafting may represent a promising alternative approach for treating baldness in men and women. A single treatment of SVF injected in the scalp of patients with AGA significantly increased hair density within 6 months. Further research is required to determine the optimal treatment regimen.

Abbreviations

ADSCs: Adipose-derived stem cells; MSCs: mesenchymal stem cells; AGA: androgenetic alopecia; SVF: stromal vascular fraction; PRP: platelet- rich plasma; RL: Ringer's lactate; HRR: HuriCell reagents; VEGF: vascular endothelial growth factor; KGF: keratinocyte growth factor; EGF ; epidermal growth factor; TGF-β1: transforming growth factor-β1

Declarations

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Availability of data and materials

All data generated or analyzed during this study are included in this published article.

Authors' contributions

SJ kim, IL Chung and BR Do contributed to conception, study design, and conduction of the study. MJ Kim, YJ Lee, JW Choi, and JH Kim contributed to experimentation and data collection. YH Do contributed to data analysis and interpretation. JC Lee contributed to manuscript writing and editing. DH Kim and Ill Chung contributed to patient selection and sample procurement. All authors read and approved the final manuscript.

Ethics approval and consent to participate

The study was conducted in strict adherence to the tenets of the Declaration of Helsinki, and it was retrospectively registered in https://cris.nih.go.kr/ (Identifier: KCT0005880). The protocol was approved by the institutional review board of Korea National Institute For Bioethics Policy (KNIFBP) as previously under the academic regulations of the public institution. All patients provided written informed consent and fresh samples were procured by Dr. Sung Ill Chung (plastic surgeon) from Top Plastic surgery hospital at Gangnam-gu, Seoul, Korea. The first patient was enrolled in Nov. 2020.

Consent for publication

Written informed consent for publication of their clinical details and/or clinical images was obtained from the patient/parent/guardian/relative of the patient. A copy of the consent form is available for review by the Editor of this journal.

Competing interests

The authors declare that they have no competing interests related to this study.

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Figures

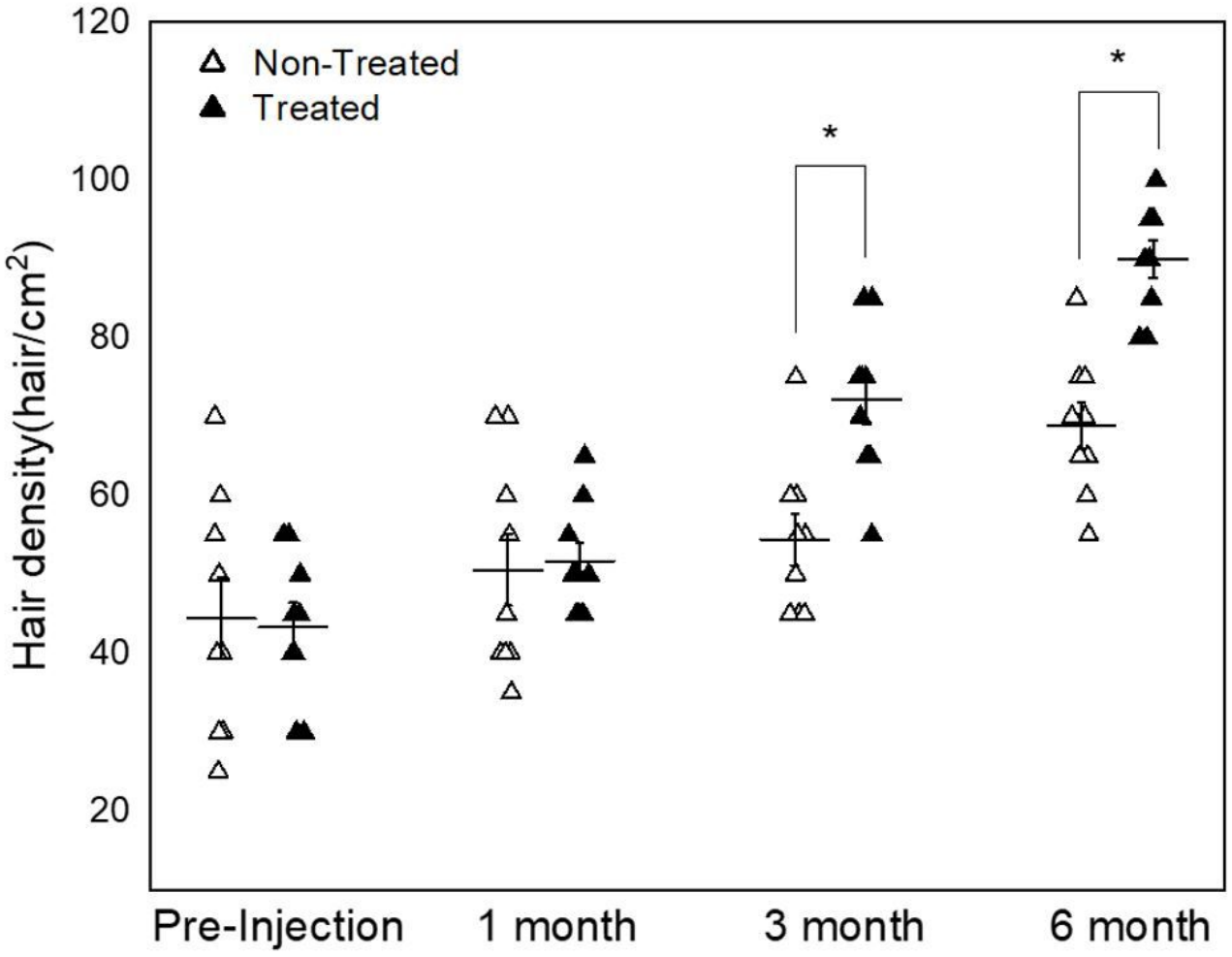

Figure 1

Hair density before and after the treatment of the right side of the scalp with SVF. Patients that were analyzed pre-injection, and 1, 3, and 6 months post-injection after SVF treatment. * n = 9; $p < 0.05$.

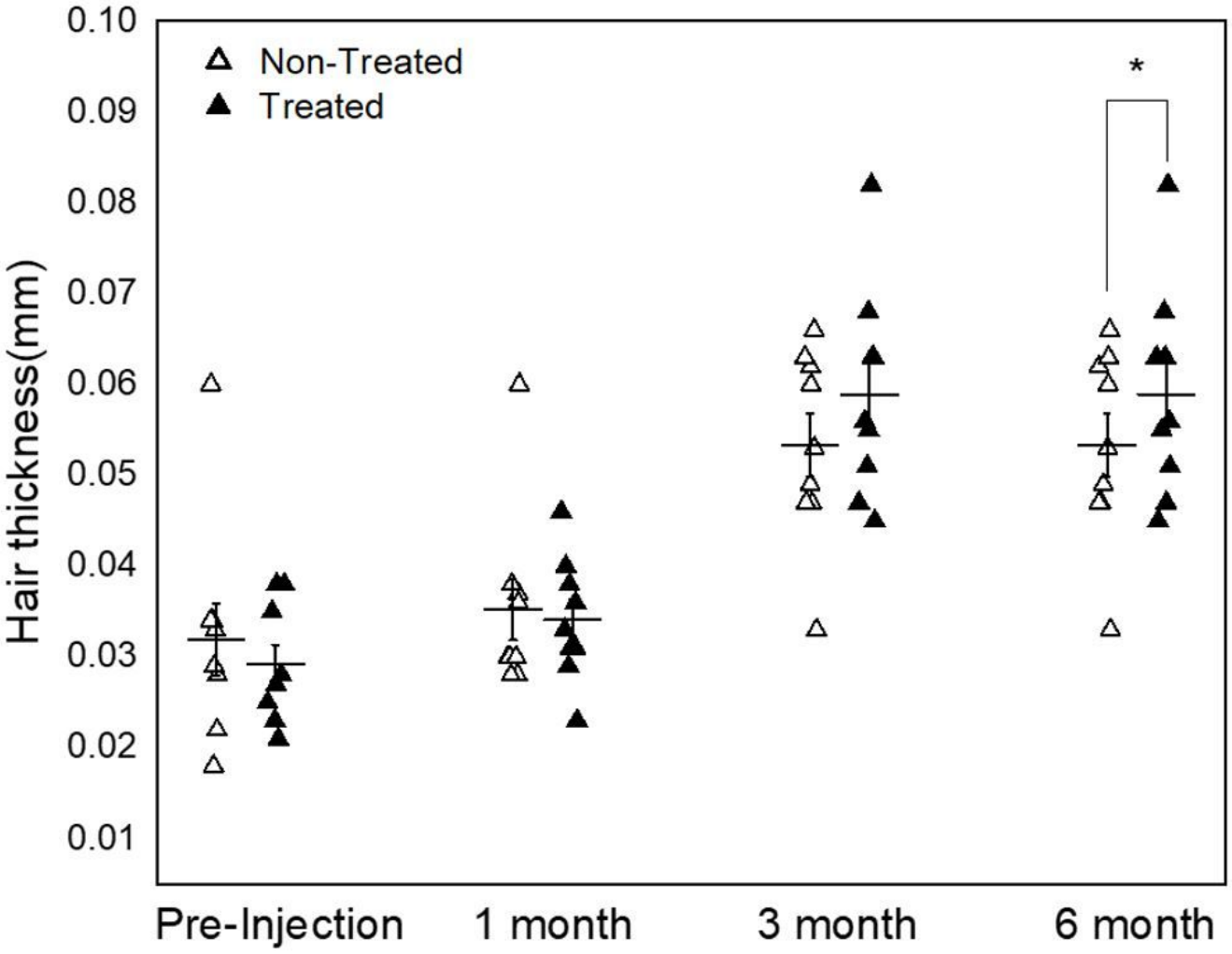

Figure 2

Hair thickness before and after the treatment of the right side of the scalp with SVF. Patients were analyzed pre-injection, and 1,3 and 6 months post-injection after SVF treatment n = 9; * $p < 0.05$

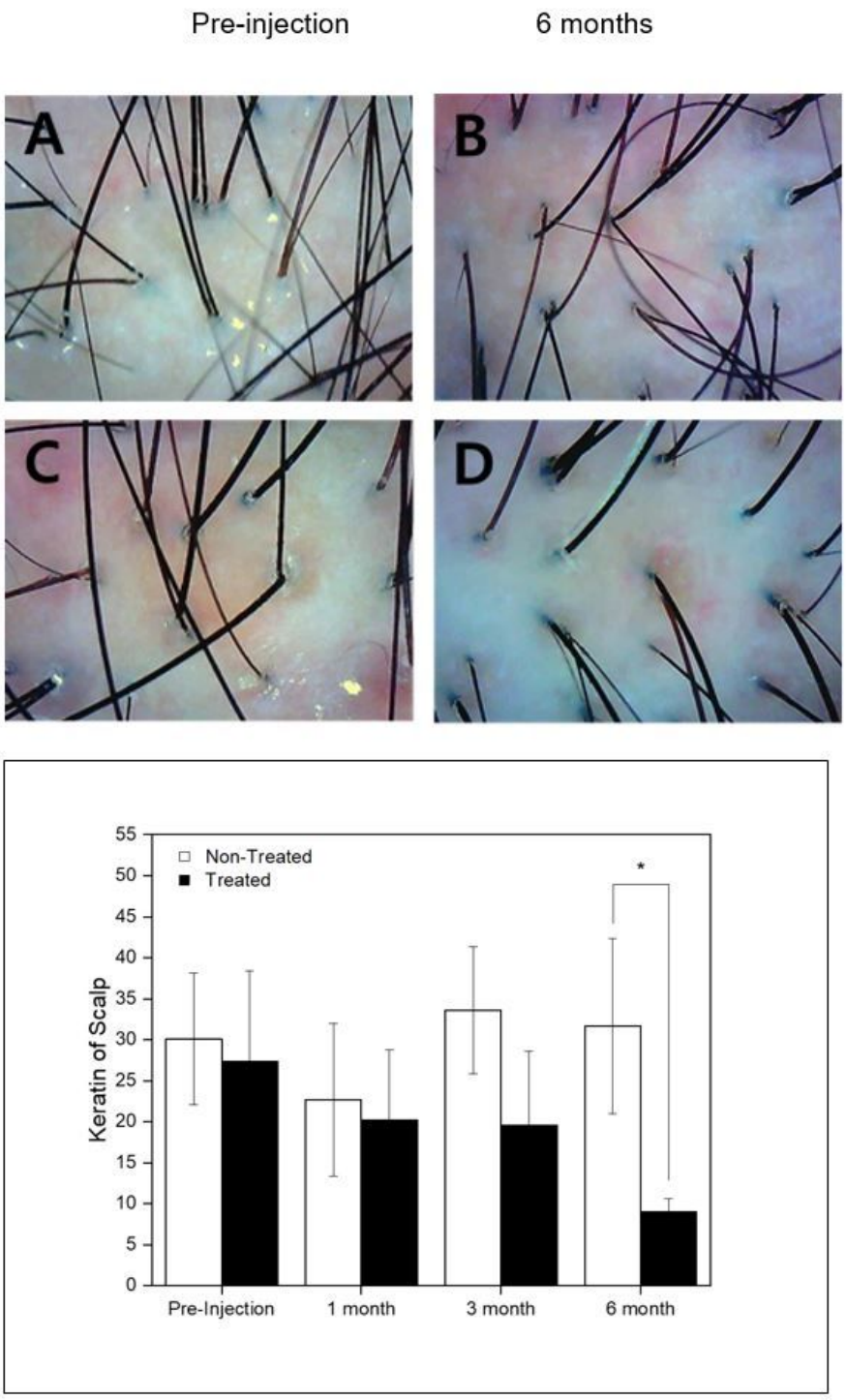

Figure 3

Representative image of Keratin of Scalp pre-injection and 6 months after SVF treatment. A 51 year old men (A, B) and 43 year old woman (C, D) decreased the score of keratin of scalp after 6 months post injection. Data are shown in preinjection, beginning of study; 1 month, 3 months, and 6 months. *p < 0.05

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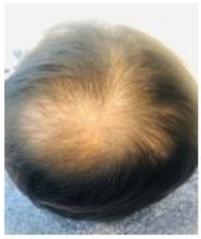
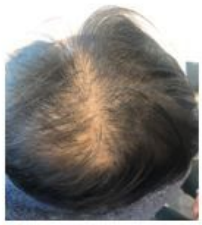
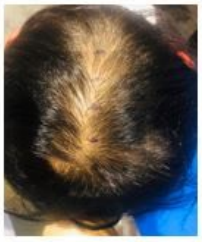
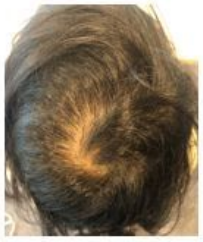
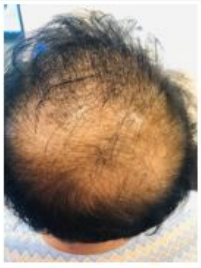
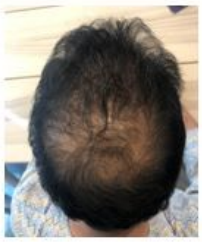
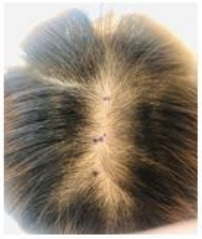
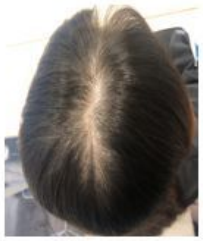
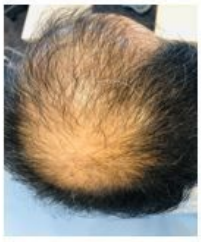
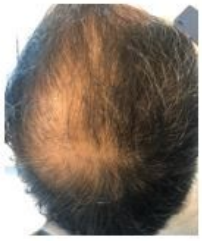
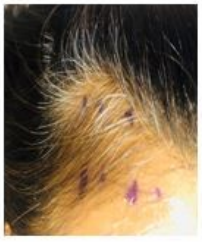
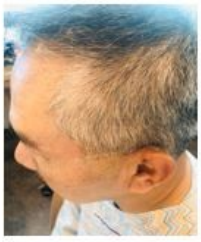
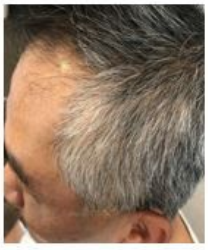
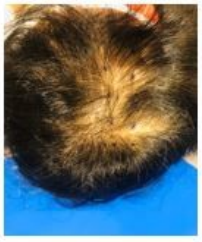
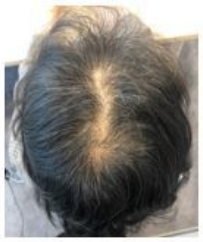
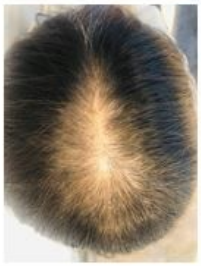
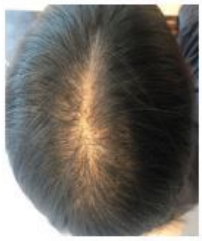
1			6		
2			7		
3			8		
4			9		
5					

Figure 4

Representative photographs documenting the increase in hair counts after SVF cell treatment. Baseline (pre-injection) versus 6 months (post-injection) global photographs of treated vertex are shown.