syndrome, and uncombable hair syndrome (pili trianguli et canaliculi). They present at or shortly after birth, and most cases are associated with other systemic conditions. Uncombable hair syndrome is similar to APKH; however, the SEM cross-section appears triangular, which is different from the presentation of APKH. Diffuse partial woolly hair (DPWH) and environmental factors such as trauma, radiation and drugs should also be ruled out. DPWH comprises predominantly normal straight hairs intermingled with thinner curly hairs. DPWH usually involves the whole hair shaft and patients complain of hair loss.

Acquired progressive kinking of the hair can progress to hair thinning and androgenetic alopecia or resolve to normal hairs. Better prognosis may be expected in female or prepubertal patients and those with involvement of non-androgen-dependent areas of the scalp. There are no effective treatments for APKH. Topical minoxidil is regarded as an alternative treatment; however, it is generally unable to prevent androgenetic alopecia.

Ki-Hun SONG,[1] Jin PARK,[1,2] Seok-Kweon YUN,[1,2] Han-Uk KIM,[1,2] Ji-Hyun YI[3]
[1]*Department of Dermatology,* [2]*Research Institute of Clinical Medicine, Chonbuk National University Medical School, and* [3]*Jun & Jung Dermatologic Clinic, Jeonju, Korea*

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Effects of topical application of growth factors followed by microneedle therapy in women with female pattern hair loss: A pilot study

Dear Editor,

The impact of female pattern hair loss (FPHL) can be more severe with greater psychological distress and impaired social function for women as compared with men. Women place a greater emphasis than men on their physical appearances.[1] The growth and development of hair follicles is influenced by a number of growth factors and cytokines. In the present study, the effects of growth factors were evaluated by a scalp-split, single-blinded and placebo-controlled trial.

Eleven Korean women (mean age, 41.36 ± 2.43 years) with FPHL were enrolled in the study. The severity of FPHL was classified into the Ludwig grade I in all patients. Patients who had undergone treatments with any medication that can affect the hair cycle within 6 months were excluded. Differential diagnoses, such as telogen effluvium and alopecia areata, were evaluated by a dermatologist. All patients were healthy without any medical problems. The study was reviewed and the study protocol was approved by the local ethics committee of the Yeouido St Mary's Hospital Institutional Review Board. The treated side of the scalp was randomly selected in all patients. Growth factor solution (SGF57; Mediway, Seoul, Korea) was topically applied on the treated half of the scalp and followed by microneedle therapy (Dr Back 10 story FNS FN-1; Dongbang Medi-care, Bundang, Korea). The other half of the scalp (control side) was treated with normal saline followed by microneedle therapy. The major components of the topical solution used for treatment were basic fibroblast growth factor (2.5 μg/mL), insulin-like growth factor-1 (1 μg/mL), vascular endothelial growth factor (2.5 μg/mL), stem cell factor (2.5 μg/mL), keratinocyte growth factor-2 (2.5 μg/mL), superoxide dismutase-1 (5 μg/mL) and Noggin (2.5 μg/mL). The target proteins were produced using the KGMP facility for pharmaceuticals at the Daejeon Bio Venture Town (Daejeon, Korea).The *Escherichia coli* host strain used in this study was BL21 (DE3) whose chromosome carries the T7 RNA polymerase gene under the control of the lacUV5 promoter. The gene encoding each target protein was inserted downstream of the T7 promoter to induce high-level expression of the target protein. A protein disulfide isomerasePDI fusion system was used to obtain the target protein in a soluble form. Each patient received five treatments at

Correspondence: Hyun Jeong Park, M.D., Department of Dermatology, Yeouido St Mary's Hospital, College of Medicine, The Catholic University of Korea, 62 Yeouido-dong, Youngdeungpo-ku, Seoul, 150-713 Korea. Email: hjpark@catholic.ac.kr
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Table 1. Mean hair densities on the growth factor-treated half and the control half of the scalp

	Mean hair shafts count (±SD)		
	Growth factor treated side	Control side	*P*-value
Baseline	47.09 ± 10.24	48.91 ± 13.02	0.4198
Week 1	48.00 ± 8.96	48.27 ± 11.77	0.8875
Week 2	54.18 ± 8.92	48.27 ± 8.06	0.0016
Week 3	51.55 ± 10.21	47.91 ± 10.81	0.0831
Week 4	53.64 ± 12.47	45.82 ± 10.75	0.0042
Week 5	52.91 ± 10.85	45.91 ± 9.98	0.0001

SD, standard deviation.

weekly intervals. Nine 33-G microneedles were installed in a device that automatically moves in the vertical direction with a depth of 0.5 mm and a constant rotational speed of 1500 rpm (3.8 *g*). Photographs of 11 patients were taken at baseline and first, second, third, fourth and fifth treatments. The photos were taken by the same operator using the same conditions at the same point of the scalp; the intersection points between the vertical line extending from the lateral margin of the eyebrow and the horizontal line extending from the external auditory canal. A digital microscope (AM313T, Dino-Lite; AnMo Electronics, Taiwan) was used to take phototrichogram images. An investigator blinded to the study counted the number of hair shafts using phototrichogram images taken with the digital microscope.

The mean hair shaft densities on both the treated and control halves of the scalp were not significantly different at baseline. However, the differences in hair shaft density were significant at the second, fourth and fifth weeks (Table 1). The mean change in hair shaft count at each week compared with baseline was calculated. An increase of more than 10% compared with baseline was observed on the treated side. The mean changes were significantly different between the treated side and control side at the weeks 2–5 (Fig. 1a). All patients answered the questionnaires regarding patient satisfaction for each side of the scalp. The mean satisfaction score on the treated side was 6.78 ± 0.51 (0 = dissatisfied, 5 = neutral, 10 = very satisfied). Satisfaction tended to increase with respect to the treated side, but not to the control side (mean satisfaction score of 4.96 ± 0.95) (Fig. 1b). There were no adverse reactions related to the treatment. Pain scores, which assessed the pain induced by microneedle therapy, indicated only marginal pain on the scalp (mean score of 2.32 ± 0.67 for the treated side and 1.86 ± 0.62 for the control side; this difference was not statistically significant).

There has been no clinical study in which growth factors were topically applied on the scalp for the purpose of growing hair. In the present study, microneedle therapy was used to enhance drug penetration.[2] Microneedles increase skin permeability by creating holes across the stratum corneum, thereby permitting drug entry.[3] The effects of the topical application of growth factors were suggested to result from the effective

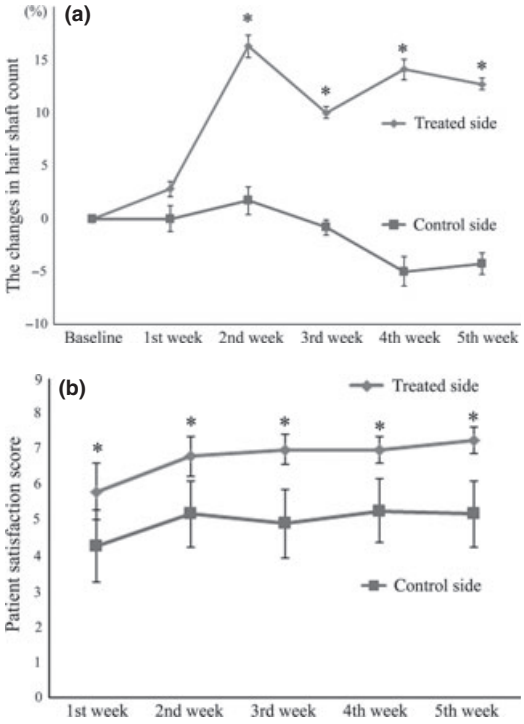

Figure 1. (a) The changes in hair shaft count. The rate of change on the treated side was significantly different from that on the control side. The mean change on the control side was −0.02 ± 1.2 2%, 1.71 ± 1.30%, −0.82 ± 0.70%, −4.99 ± 1.38% and −4.23 ± 1.01% at weeks 1, 2, 3, 4 and 5, respectively. On the treated side, the mean change in hair shaft count tended to increase. The mean change on the treated side was 2.83 ± 0.71%, 16.28 ± 1.06%, 9.99 ± 0.55%, 14.08 ± 0.98% and 12.70 ± 0.58% at weeks 1, 2, 3, 4 and 5, respectively ($n = 11$). *$P < 0.05$, the bars on the graph represent standard error. (b) Patient satisfaction scores. Patient satisfaction scores for the treated side were significantly higher than those for the control side during the treatments. The satisfaction scores for the treated side at weeks 1, 2, 3, 4 and 5 were 5.82 ± 0.81, 6.82 ± 0.55, 7.00 ± 0.43, 7.00 ± 0.38 and 7.27 ± 0.38, respectively. The satisfaction scores for the control side at weeks 1, 2, 3, 4 and 5 of treatment were 4.27 ± 1.01, 5.18 ± 0.94, 4.91 ± 0.98, 5.27 ± 0.90 and 5.18 ± 0.93, respectively ($n = 11$). *$P < 0.05$, the bars on the graph represent standard error.

penetration afforded by microneedle therapy. The present study provides a novel treatment option of FPHL, which is safe and effective for enhancing hair density.

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Young Bok LEE,[1,2] Young Sun EUN,[1,2]
Ji Hae LEE,[1,2] Min Seok CHEON,[1,2]
Yong Gyu PARK,[1,2] Baik Kee CHO,[1,2]
Hyun Jeong PARK[1,2]
[1]*Department of Dermatology, Yeouido St Mary's Hospital, and*
[2]*Department of Biostatistics, College of Medicine, The Catholic University of Korea, Seoul, Korea*

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Reply to Dr Tomita's letter

Dear Editor,

We think the unpleasant appearance of dyschromatosis symmetrica hereditaria (DSH) may have psychosocial impact such as causing depression and that this is a novel clinical finding of the disease.

When we prepared our manuscript, a PubMed search of the English-language published work did not find any reports of DSH associated with depression. The unpleasant appearance of DSH may have psychosocial impact such as causing depression as described in our case, which had not been reported previously. We have discussed the relationship between DSH and depression in our letter. We think this is a novel clinical finding of the disease. Statistical and logical explanation of the relationship between depression and the *ADAR1* gene mutation cannot be established because only one mutation of *ADAR1* had been reported in a coexisting patient. It seems that the unpleasant appearance of DSH caused depression in our case more than an intrinsic molecular mechanism. We believe that more genetic studies on DSH and depression are needed for statistical and logical explanation of the relationship between depression and *ADAR1* gene mutation.

We apologize for our carelessness in preparing our manuscript and incorrectly citing reference 1 in the second sentence of the first paragraph. Reference 1 should be correctly cited in the first sentence of the first paragraph as follows "Dyschromatosis symmetrica hereditaria (DSH, Mendelian Inheritance in Man no. 127400) is a pigmentary genodermatosis characterized by a mixture of hyperpigmented and hypopigmented macules distributed on the back of the extremities.[1]" The second sentence of the first paragraph should cite reference 4 correctly, as Dr Tomita mentioned.

We thank Dr Tomita for his question and pointing out our incorrectly cited reference 1. We attempt to reply satisfactorily. In the future, we should be more rigorous in our research.

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Suju LUO,[1] Yan ZHENG,[2] Haiyang NI,[1] Yan LIU,[2]
Yuanjun LIU,[1] Xiaoli LI,[2] Quanzhong LIU[1]
[1]*Department of Dermatology, Tianjin Medical University General Hospital, Tianjin, and* [2]*Department of Dermatology, Second Hospital of Xi'an Jiaotong University, Xi'an, China*

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Correspondence: Quanzhong Liu, M.D., Ph.D., Department of Dermatology, Tianjin Medical University General Hospital, 154 Anshan Dao, Tianjin, 300052, China. Email: quanzhongliu2008@163.com
Author contribution: X. L. and Q. L. contributed equally to this work.

