OPEN

PRS GLOBAL OPEN

ORIGINAL ARTICLE
Cosmetic

Eyebrow Transplantation Using Long Hair Follicular Unit Excision Technique

Jae Hyun Park, MD, PhD*
Na Rae Kim, MD*
Kotchamol Manonukul, MD†

Background: Long hair follicular unit excision (LHF) allows surgeons to fully visualize hair curliness, which is crucial in eyebrow transplantation where matching curliness is a matter of utmost importance. In this study, we aimed to evaluate the clinical importance of LHF in eyebrow transplantation.
Methods: A total of 36 patients who had undergone eyebrow transplantation surgery with LHF were enrolled. Twelve of the 36 patients had previously undergone unsatisfactory surgery at another clinic. Of these, 2 patients underwent complete laser eyebrow removal, and 3 patients underwent selective electro-cautery with unmatched hair curliness before surgery. The remaining 7 patients underwent surgery to increase eyebrow hair density or to reshape their eyebrows. A satisfaction survey was administered to patients > 6 months after the procedure.
Results: All patients showed natural eyebrow transplant results at their follow-up visits and were satisfied with the results. Patient and surgeon satisfaction scores were 4.7 and 4.3, respectively. Four patients underwent a touch-up procedure to increase hair density with 21, 43, 12, and 45 follicular units, respectively, and were satisfied with the results. There were no cases of asymmetry or adverse events, such as folliculitis.
Conclusions: The authors derived satisfactory results from the patients who underwent eyebrow transplantation by the LHF method. Therefore, we conclude that LHF is a suitable surgical method for eyebrow hair transplantation. *(Plast Reconstr Surg Glob Open 2021;9:e3598; doi: 10.1097/GOX.0000000000003598; Published online 25 May 2021.)*

INTRODUCTION

Follicular unit transplantation (FUT) was first developed in the 1990s by Limmer.[1] Follicular unit excision (FUE) was later introduced by Rassman and Bernstein in 2002.[2] FUE surgery gained popularity because it spares patients from a linear donor scar and significantly reduces postoperative pain.[3] However, donor area shaving is a major hindrance to patients. The demand for non-shaven (NS)-FUE has grown because some patients are unwilling to undergo head shaving due to social, occupational, and/or personal reasons.

In 2006, Marcelo Pitchon introduced the concept of preview long hair transplantation.[4] This method enables visualization of the results after 1 postoperative year by transplanting long hair. With this approach, surgery is unnoticeable. In 2016, long hair FUE (LHF) was first introduced by Boaventura,[5] who emphasized the advantage of donor area preview.

NS-FUE is largely divided into pre-trimming (PT), the direct method (DM), and LHF.[6,7] PT is a 2-step technique in which target grafts are trimmed up to 1 mm in length and harvested. DM is a 1-step technique where the punch tip cuts and dissects around the graft. DM leaves the hair shaft approximately 0.3–0.6 mm in length. Shaft length can be somewhat controlled during PT. However, 2 or 3 hair follicular units (FUs) can hardly be encased into the commonly used 0.8–1.0-mm punch tip, which makes this approach inefficient.

LHF provides all the benefits of ordinary FUE surgery, such as less postoperative pain and no linear scar. It also provides the benefits of NS-FUE, such as no requirement for shaving, as well as the merits of transplanting grafts with long hair strands. It not only allows donor and recipient area preview as mentioned by Pitchon and Boaventura, but it also allows surgeons to view hair curliness, which is a crucial factor in certain types of hair transplant surgery. Its clinical significance is accentuated

*From the *Dana Plastic Surgery Clinic, Gangnam-gu, Seoul, Korea; and †V Design Hair by Dana International, Vibhavadi Hospital, Bangkok, Thailand.*

Received for publication January 27, 2021; accepted April 6, 2021.

DOI: 10.1097/GOX.0000000000003598

Disclosure: *Dr. J.H. Park has patents and ownership interest in Seson medical company. The other authors have no financial interest to declare in relation to the content of this article. This study received no funding.*

in eyebrow transplant surgery, where matching hair curliness is a matter of utmost importance.[8] The present study reports satisfactory results in patients who underwent eyebrow transplant surgery with LHF and provides a review of the literature.

MATERIALS AND METHODS

A total of 36 patients who underwent eyebrow transplant surgery with LHF were enrolled. Patients completed >6 months of follow up. All patients were men, with an age range of 24–68 years and a median age of 33.8 years. The study was performed in accordance with the principles of the Declaration of Helsinki. Written informed consent was obtained from all patients, and consent for the use of clinical photographs was received from patients whose images were used in the study.

Twelve of the 36 patients had previously undergone unsatisfactory surgery at another clinic. Of these, 2 patients underwent complete laser eyebrow removal, and 3 patients underwent selective electro-cautery with unmatched hair curliness before surgery. The remaining 7 patients underwent surgery to increase eyebrow hair density or to reshape their eyebrows. Patients who underwent postoperative forehead lifting or forehead shortening by surgical excision and patients who developed soft tissue tumors were excluded from the study.

A satisfaction survey was administered to patients > 6 months after the procedure. Written informed consent was obtained from patients before the survey. Medical charts and photographs were retrospectively reviewed. Patients and surgeons scored the results in terms of satisfaction using the 5-point Likert scale (1 point, very dissatisfied; 2 points, dissatisfied; 3 points, neither satisfied nor dissatisfied; 4 points, satisfied; 5 points, very satisfied). The survey questions were as follows: (1) How satisfied are you overall with the surgical results? (2) How natural do you think the results look?

OPERATIVE PROCEDURE

Preoperative Design

The optimal preoperative design was determined through sufficient communication with the patient looking into a mirror in a sitting position. An eyebrow pencil was utilized to draw the design, rub it off, and redraw repeatedly to produce an accurate and finalized design while the patient looked into a mirror. A surgical marking pen was then used to re-mark the margin and locations of the midline and peak point.

Donor Harvesting

Patients assumed a sitting position, while the surgeon harvested in a sitting or standing position. The GraMAX FUE punch machine (Seson Medical Company, Seoul, Korea) with an open-window punch was used for LHF. The lower occipital area or temporal sides were used as donors to harvest as thin as possible.

The open-window punch can only be operated in oscillating mode because hair would tangle around the punch tip in rotating mode. According to the authors' experience, it helps to set the oscillating angle to < 270 degrees. Tumescent injection with traction around the punching site to make it more tense is also useful.

Implantation

Harvested long hair was trimmed to ~1–2 cm in length. A potadine-cotton ball was squeezed to eliminate excess moisture and used to dab the recipient site to prevent smudging of the surgical design. Local injection was applied ~1 cm above the surgical design with the needle facing downwards, followed by the tumescent injection. To recognize symmetry on both sides, the volume of local injection was as small as possible, and injections were administered in equal volumes. Long hair was loaded into a sharp implanter with a diameter of 0.6 mm and planted delicately and strictly, aligning by curl. After graft insertion, long implanted hairs were trimmed using sharp iris scissors to achieve a normal eyebrow hair length.

Final Check on the Recipient Site

The patient position was switched from supine to sitting to check for eyebrow symmetry. Patients were also requested to confirm symmetry by looking into a mirror. Surgery was concluded when everything was deemed sound (Fig. 1).

RESULTS

Patients showed very natural eyebrow transplant surgery results upon their follow-up visits and were satisfied with the results. Patient and surgeon satisfaction scores were 4.7 and 4.3, respectively. Four patients underwent a touch-up procedure to increase hair density with 21, 43, 12, and 45 FUs, respectively, and were satisfied with the results. There were no cases of asymmetry or adverse events, such as folliculitis.

REPRESENTATIVE CASES

Case 1

A 30-year-old man with very thick curly donor hair of ≥90 μm had previously undergone eyebrow hair transplant surgery at another clinic using FUE. The results looked unnatural because the curls of transplanted hairs were not matched. Eyebrow hairs with curls that did not match the original arch of the eyebrow were removed by electro-cautery. Revision surgery by LHF took place 2 months after hair removal (186 FUs in total) (Fig. 2).

Case 2

A 34-year-old man visited our clinic with a very awkward-looking surgical result. Eyebrow hairs did not match up with the curliness of existing hairs after FUE at another clinic. Occipital donor hair was as thick as 86 μm on average. Eyebrow hairs were entirely removed by laser hair removal. The patient underwent revision eyebrow transplant surgery 3 months after hair removal with 321 FUs by LHF (Fig. 3).

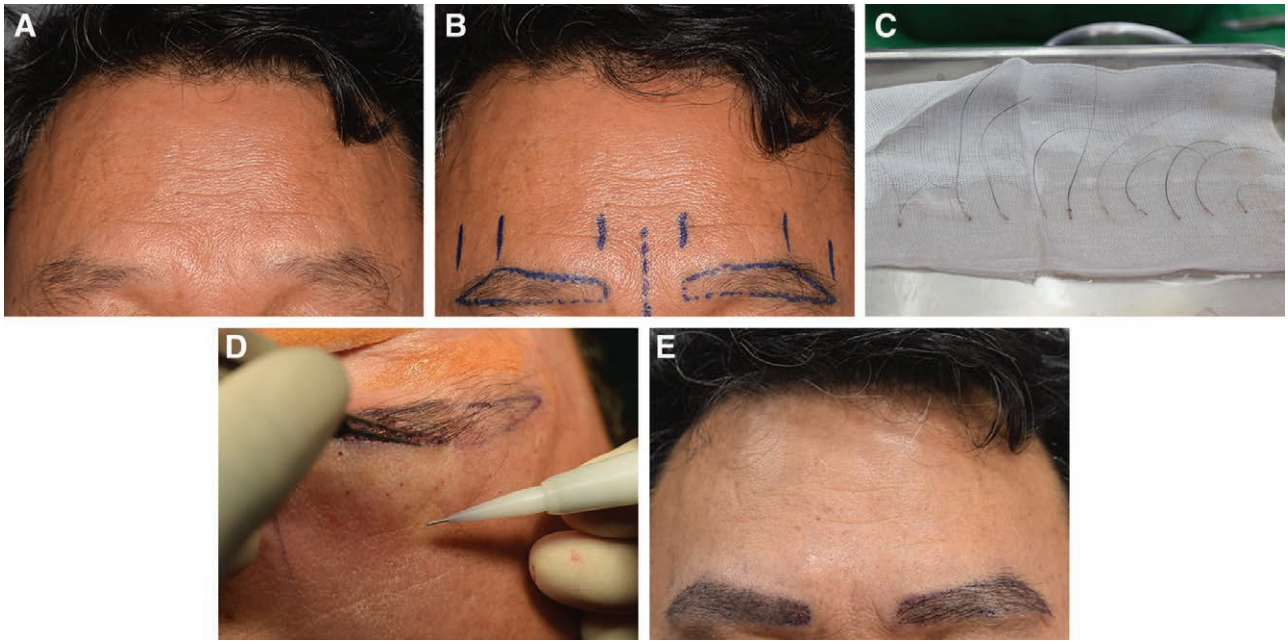

Fig. 1. A 52-year-old man who underwent eyebrow transplant surgery, and the process of LHF. A, Preoperative view. B, Preoperative design. C, Harvesting of long hairs using the LHF technique. D, Implantation with a sharp implanter. E, Immediate postoperative view.

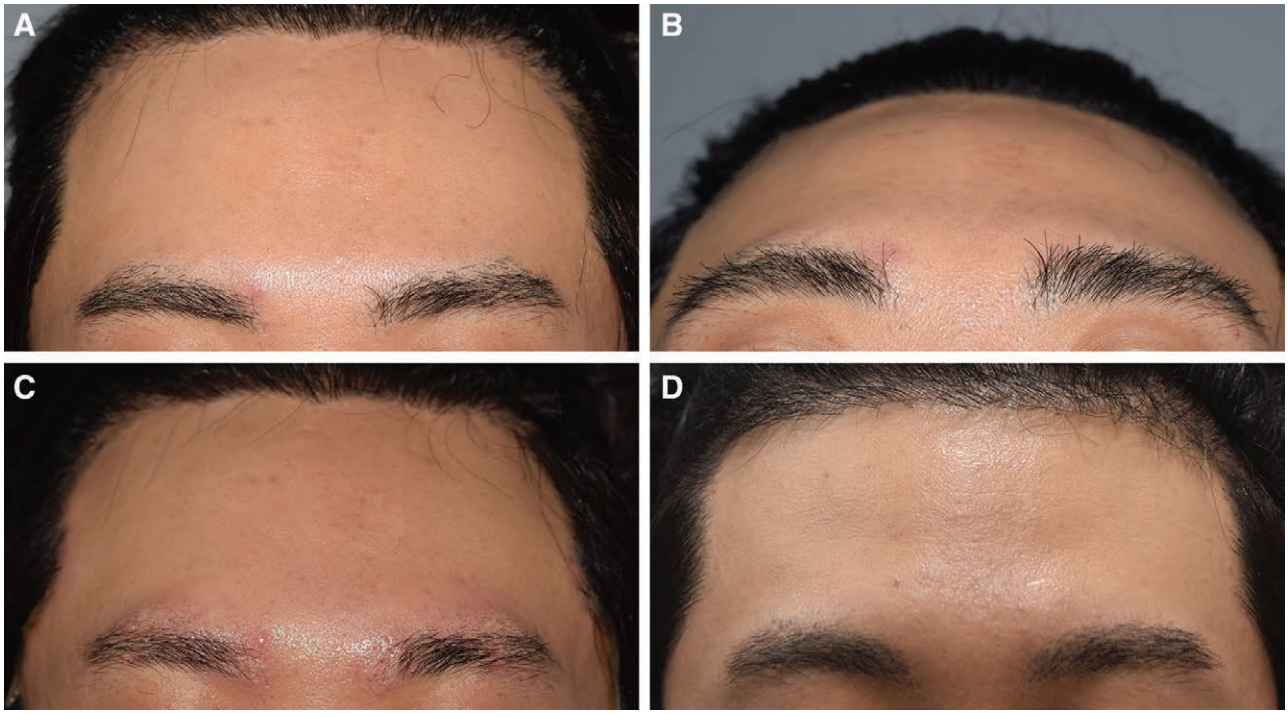

Fig. 2. A 34-year-old man who underwent revision hair transplant surgery after hair removal by electrolysis. A, Preoperative frontal view (upon the first visit, before hair removal by electrolysis) showing an awkward eyebrow appearance from unmatched hair curls. B, Preoperative photograph: bottom view (upon the first visit, before hair removal by electrolysis). C, Preoperative photograph taken after hair removal. D, Six months after revision hair transplant surgery by LHF.

Case 3

A 28-year-old man visited the clinic with congenitally faint and sparse eyebrows. A total of 312 FUs were transplanted by LHF (Fig. 4).

DISCUSSION

Hair transplant techniques are rapidly evolving. Direct NS-FUE was first introduced by Park in 2014.[9] With this approach, it is possible to harvest donor hair without

Fig. 3. A 32-year-old man who underwent revision eyebrow restoration surgery after laser hair removal. A, Awkward eyebrow appearance with unmatched hair curls upon the first clinic visit. B, Both eyebrows were entirely removed using laser hair removal. Preoperative photograph taken after laser hair removal. C, Eight months after surgery.

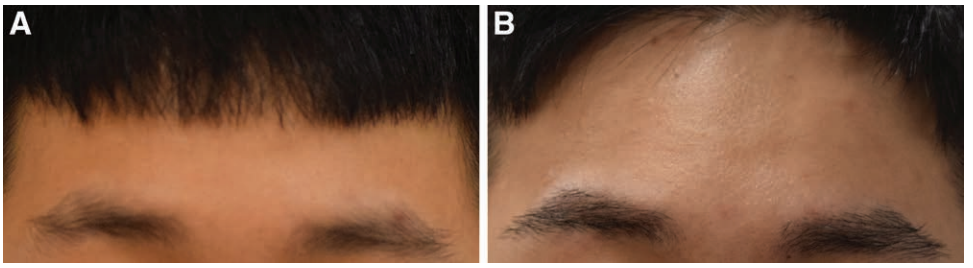

Fig. 4. Faint eyebrows corrected by LHF. A, Preoperative view. B, Ten months after surgery.

shaving or trimming. NS-FUE advanced to LHF, which does not require trimming or shaving, and long hair strands are left uncut after harvesting. The gist of LHF lies in acquiring healthy hair follicles with long hair shafts without tangling. Use of a special type of punch tip is mandated.

Park emphasized the following concepts, which are crucial to LHF. First, the oscillating motion should be kept within 270 degrees for easier insertion of hair shafts through the open slot. Second, a function that returns the slot to its original position each time should be used (Fig. 5). Here, the open slot can be single, double, or triple and even short or long. The edge of the punch tip can also vary, and may be blunt or partially sharp.

LHF possesses all the merits of FUE, such as less postoperative pain, no linear donor strip scarring, and no donor shaving. In addition, it provides an immediate vision of the possible final result at 1 postoperative year by grafting follicles with long hair strands. Boaventura's concept of donor preview is also important.[5] However, the authors find such a concept useful only when treating patients with severe donor depletion after several previous hair transplant surgeries.

Fig. 5. Open-window punch.

Next is the concept of visualizing hair curliness (Fig. 6). This is the main benefit of LHF. LHF is not routinely advised, but it is recommended for cases where matching natural curliness, as well as adjacent transplanted hair, is important, such as eyebrow hair transplantation, sideburn reconstruction, and temporal and side hairline correction.[10,11]

LHF also has its disadvantages. The surgical duration may be long, and the approach is technically difficult. Therefore, LHF is not a substitute for conventional FUE methods. Rather, it is a good option for those who do not wish the surgery to be obvious for social, occupational, and/or personal reasons. Also, a mega session is never an adequate indication for LHF. The best indications are surgeries requiring delicate matching of hair curliness, such as eyebrow hair transplantation or sideburn reconstruction.

There are several tips for achieving successful LHF. First, bleeding control is important. The long hair strands of the target graft, as well as those of adjacent hair follicles and blood clots, are a hindrance to maintaining a clear surgical view. Well-planned use of local anesthesia and tumescent solution mixed with epinephrine help control bleeding. Second, a sitting position is preferable to a prone position (Fig. 7)[12] for both ergonomic and technical reasons. However, ergonomics may not be a problem in eyebrow hair surgery, which requires lesser amounts of donor hair than usual. Its importance increases in proportion with the donor's requirements. When the patient is in a prone position, profuse bleeding makes surgery difficult if hair gets tangled due to blood clots. Third, upward traction when sweeping up hair from above helps tremendously in

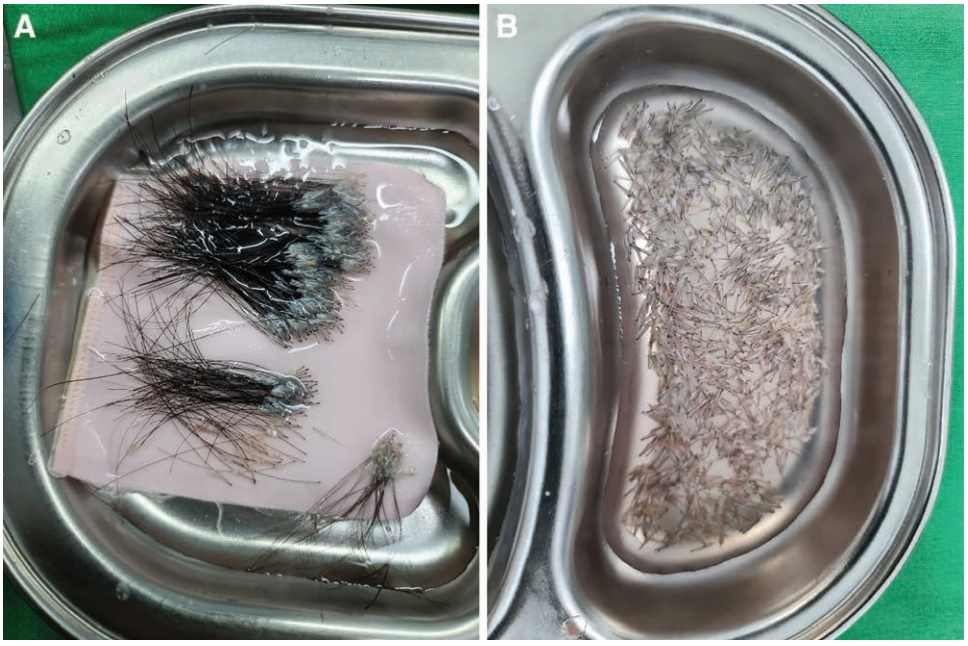

Fig. 6. Comparison of remaining hair shaft length between the 2 methods of NS-FUE. A, A graft extracted by LHF with readily visible hair curls. B, A graft extracted using the conventional follicular unit excision method with the hair shaft as short as 1 mm (too short to read hair curliness).

achieving efficient surgery (Fig. 8).[12] Upward traction helps gain a clearer surgical view and prevent hair tangling, which is a visual obstruction to the surgeon. Fourth, it is advantageous to set the location of the open window slot in the 10 o'clock direction. Upon completion of each graft dissection, the slot automatically returns to its original position for the hair strands to easily slip into the punch-tip lumen through the slot. Eyebrow hair transplantation requires acquisition of a thinner caliber hair from the donor region. Nape hair and body hair are also possible donor sources. Of the occipital donor area, the hair caliber is narrower at both temporal sides and at the lower occipital area compared with other areas. Some surgeons use 2 FUs at the center and a single FU at the periphery. The authors believe that using only single hair follicles provides the most esthetic

Fig. 7. Surgeon sitting or standing behind the patient.

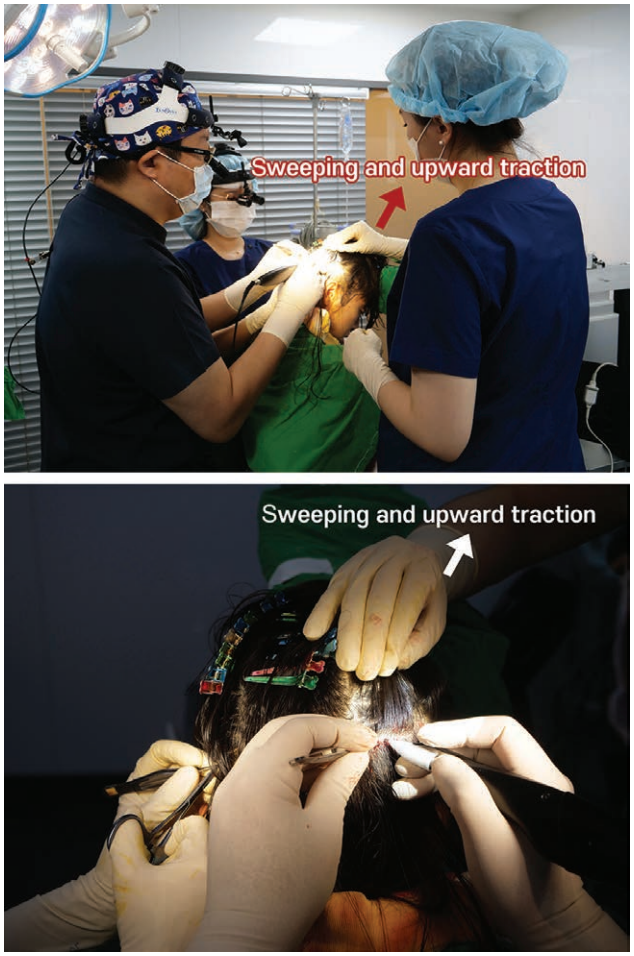

Fig. 8. Sweeping and upward traction. A, Sweeping and upward traction by assistant standing on same side with operator. B, Close-up view.

surgical result. For graft placement, working in the direction from the eyebrow head to the eyebrow tail reduces graft popping, and matching hair curliness and maintaining an acute angle achieves a natural result.

CONCLUSION

Through our experience, we conclude that LHF, when performed by a surgeon with sufficient skills and expertise, is a suitable surgical method for eyebrow hair transplantation.

Jae Hyun Park, MD, PhD
Dana Plastic Surgery Clinic, Samju Building 10F,
Gangnamdaero 606, Gangnam-gu,
Seoul, Korea
E-mail: Jay8384@naver.com

ACKNOWLEDGMENT

We thank Emily Woodhouse, PhD, from the Edanz Group (https://en-author-services.edanz.com/ac) for editing a draft of this article.

REFERENCES

1. Limmer BL. Elliptical donor stereoscopically assisted micrografting as an approach to further refinement in hair transplantation. *J Dermatol Surg Oncol.* 1994;20:789–793.
2. Rassman WR, Bernstein RM, McClellan R, et al. Follicular unit extraction: minimally invasive surgery for hair transplantation. *Dermatol Surg.* 2002;28:720–728.
3. Kim YS, Na YC, Park JH. Comparison of postoperative pain according to the harvesting method used in hair restorative surgery. *Arch Plast Surg.* 2019;46:241–247.
4. Pitchon M. Preview long-hair follicular unit transplantation: an immediate temporary vision of the best possible final result. *Hair Transplant Forum Int'l.* 2006;16:113–119.
5. Boaventura O. Long hair FUE and the donor area preview. *Hair Transplant Forum Int'l.* 2016;26:200–202.
6. Park JH, You SH, Kim NR. Nonshaven follicular unit extraction: personal experience. *Ann Plast Surg.* 2019;82:262–268.
7. Park JH, You SH. Pretrimmed versus direct nonshaven follicular unit extraction. *Plast Reconstr Surg Glob Open.* 2017;5:e1261.
8. Tomc CM, Malouf PJ. Eyebrow restoration: the approach, considerations, and technique in follicular unit transplantation. *J Cosmet Dermatol.* 2015;14:310–314.
9. Park JH. Direct non-shaven FUE technique. *Hair Transplant Forum Int'l.* 2014;24:103–104.
10. Park JH. A novel concept for determining the direction of implanted hair in hairline correction surgery in East Asian women. *Arch Plast Surg.* 2018;45:292–294.
11. Park JH. Side-hairline correction in Korean female patients. *Plast Reconstr Surg Glob Open.* 2015;3:e336.
12. Park JH, You SH, Kim N. Forehead-supporting chair system for follicular unit extraction hair transplantation. *Arch Aesthetic Plast Surg.* 2019;25:42–44.