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ORIGINAL ARTICLE FACIAL SURGERY

Secondary Revision of Female Hairline Correction Surgery: Personal Experience

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Abstract Patients undergoing secondary female hairline correction surgery present with dissatisfaction of various causes that require specific solutions. Satisfactory results following secondary revision surgery are achieved only after consideration of the reasons for the patient's dissatisfaction as well as specific factors regarding the state of the hairline, height and width of the forehead, and overall facial type; all of these must be considered when choosing the most suitable surgical method. In the present study, the authors used various surgical approaches according to the patient's characteristics and presenting symptoms in the performance of secondary hairline correction surgery and evaluated the adequacy of each method using a satisfaction survey. In total, 246 patients who underwent hairline correction surgery by hair transplantation were enrolled in this study. As adjunctive procedures prior to surgery, 24 patients received triamcinolone injections every 1–2 weeks to ameliorate severe hyperfibrotic scarring, and laser hair removal was performed in part of the recipient area in 18 patients to remove old transplanted grafts that had created an awkward appearance or were unnecessary. Revision of female hairline correction surgery was performed with FUT (follicular unit transplantation) in 156 patients (63.4%), partial-shave FUE (follicular unit extraction) in 12 patients (4.9%), a combination technique (FUT + FUE) in 24 patients (9.8%), and non-shaven FUE in 54 patients (22.0%).
Level of Evidence V This journal requires that authors assign a level of evidence to each article. For a full description of these Evidence-Based Medicine ratings, please refer to the Table of Contents or the online Instructions to Authors www.springer.com/00266.

Keywords Female hairline · Hairline correction surgery · Revision

Introduction

Female hairline correction surgery is becoming increasingly popular worldwide. This surgery goes a step beyond hair restoration surgery, the objective of which is simply to grow hair where no hair growth is present. Female hairline correction surgery has evolved to include the concept of esthetic facial contouring to achieve a slimmer and more feminine appearance with more beautiful facial features [1, 2]. Female hairline correction surgery requires operative plans and methods that are completely different from those of male hairline surgery [3, 4]. Increasing numbers of patients are unsatisfied with their primary operative results and seek secondary revision surgery.

To the best of our knowledge, very few reports have focused on revision of female hairline correction surgery. Thus, we herein report our experience and present a literature review.

Materials and Methods

In total, 246 patients who underwent hairline correction surgery by hair transplantation from January 2012 to June 2017 were enrolled in this study. Patients who did not undergo a follow-up examination at 10 months postoperatively and those with a history of forehead augmentation,

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forehead lifting, or midface lifting were excluded from the study.

The patients were categorized by sex, age, recipient site, surgical method, purpose of surgery, and history of previous hair transplantation. The patients' medical charts and photographs were reviewed.

Surgical Planning

The patients' detailed surgical and medical histories were obtained prior to surgery. The recipient and donor areas were examined by visual inspection and through a folliscope. All sites involved in previous surgeries, methods used, and history were carefully checked.

Design

The surgical design was confirmed while the patient looked into a mirror, and markings were then made with a surgical pen. If the hairline from the previous hair transplantation procedure was reasonable and the sole problem was low density, the hairline design was preserved. If the forehead was still too high or broad and awkwardly transplanted old hair required camouflage, a hairline was newly created in front of the old one. If the previously created design was too low and unnatural, laser hair removal was applied to create a new hairline.

Adjunctive Procedures Prior to Hairline Correction Surgery

Patients underwent laser hair removal and/or triamcinolone injection into the recipient zone if necessary. Hyperfibrotic scarring was treated with triamcinolone injection every week or every other week to soften the recipient site for subsequent hair transplantation.

Because intralesional administration of triamcinolone is associated with significant injection pain, a 30-gauge needle was used. EMLA cream, a topical anesthetic, was applied, in advance, in patients with a heightened sensitivity to pain.

Triamcinolone diluted 1:4 with normal saline was injected mainly into the recipient area with the most fibrotic and hypertrophic changes by palpating the lesion with finger tips and inspecting with 5.5 × magnifying loupes. A single session of intralesional injection required about 0.8–2.5 cc of diluted solution.

Old transplanted grafts that had created an awkward appearance or were unnecessary were removed by laser hair removal.

The exact area of hair removal was determined after thorough discussion with the patient. The patients returned every 1–2 months for subsequent hair removal sessions. After the final session of laser hair removal, the patients were observed for 3–4 months before revision surgery to ensure lack of hair growth.

Operative Technique

The surgical method was determined after comprehensive inspection of patient's donor and recipient areas. When donor scalp laxity allowed, the follicular unit transplantation (FUT) method was chosen in patients with previous FUT scars. In such cases, as much of the old strip scar was included in the surgical design for excision. If harvesting of an adequate amount of donor hair seemed difficult due to inclusion of the strip scar, a new strip was designed at least 1 cm away after informing the patient of the two resulting scars.

Donor hairs were harvested by follicular unit extraction (FUE) if scalp laxity was insufficient or the patient chose not to proceed with strip surgery. The patients were allowed to choose between partial shaving and non-shaving.

Patient Satisfaction Survey

A five-point Likert scale was used to assess the subjective satisfaction of patients and the objective satisfaction of the surgeon at 10 months postoperatively.

The surgeon's satisfaction score was marked by two expert hair surgeons who did not participate in the particular surgical procedures for accurate and objective evaluation through preoperative and postoperative patient photographs and medical chart reviews (1, very unsatisfactory; 2, unsatisfactory; 3, average satisfaction; 4, satisfactory; 5, very satisfactory). Medical charts and photographs were retrospectively reviewed.

Results

In total, 246 female patients were enrolled in the study. Their average age was 32.6 years (range, 21–58 years).

Adjunctive Procedures Prior to Hairline Correction Surgery

Twenty-four patients received triamcinolone injections every 1–2 weeks to ameliorate severe hyperfibrotic scarring, which improved after five sessions in six patients, after four sessions in 12 patients, and after two sessions in nine patients. They underwent revision surgery only after alleviation or softening of the elevated scar tissue was observed.

Laser hair removal was performed in part of the recipient area in 18 patients every 1–2 months (four times for six patients, three times for 12 patients). Laser hair removal was not performed in patients whose previous surgery required increased density, in those whose prior hairline design could be hidden with a new hairline, or in those whose surgical results were very awkward but who still had a wide forehead so that placing more grafts in the front could conceal the previously placed grafts.

Operative Technique

The patients in this study had undergone an average of 1.68 prior hairline correction surgeries. Of all 246 patients, 156 (63.4%) had undergone 1 prior hairline correction surgery, 42 (17.1%) had undergone 2, 42 (17.1%) had undergone 3, and 6 (2.4%) had undergone 4. The interval between the last surgery and the revision surgery ranged from 10 months to 16 years (average, 3.6 years). With respect to the harvesting methods, 228 patients (92.7%) had undergone prior follicular unit strip surgery and 18 (7.3%) had undergone FUE. For graft placement, the slit method had been performed in 42 patients (17.1%) and the implanter method in 204 (82.9%). Of all 246 patients, 42 (17.1%) had undergone scalp medical tattooing or permanent makeup application to cover areas with low density or a see-through appearance.

Revision of female hairline correction surgery was performed with FUT in 156 patients (63.4%), partial-shave FUE in 12 patients (4.9%), a combination technique (FUT + FUE) in 24 patients (9.8%) because of inadequate donor scalp laxity, and non-shaven FUE in 54 patients (22.0%).

Surgical Outcomes

Postoperative follow-up examinations were performed 10 months after surgery. Patients' subjective satisfaction scores averaged 4.2/5. Physician's objective satisfaction score was 4.4/5.

Twelve patients (4.9%) underwent touch-up procedures to increase density. These patients required an average of 312 grafts, and all were satisfied with the results (Table 1).

Three patients had a persistent complaint of a wide forehead and underwent a touch-up procedure with an additional 470 grafts and advancement of the hairline 1 year after revisional hairline correction surgery (Table 2).

No adverse effects, such as folliculitis, occurred after the surgery.

A total of 24 patients (9.8%) underwent hair-thinning laser treatment. The number of laser treatments was 1 in 12 patients, 2 in 6 patients, and 3 in 6 patients. The results of hair-thinning laser treatment were satisfactory in all patients. A comparison of the hair diameter before and after treatment showed an average reduction from 78 to 66 microns.

Case Presentations

Case 1

A 28-year-old woman visited our clinic with a chief complaint of wide, asymmetric, and awkward facial appearance after hairline correction surgery at another clinic 5 years earlier. She desired an oval-shaped face and increased hair density in the frontotemporal recess and infratemple areas. In total, 712 grafts were placed with the FUT method (Fig. 1).

Case 2

A 36-year-old woman with a history of three prior hairline correction surgeries at other clinics (FUE 3 and 2 years earlier and strip surgery 1 year earlier) visited our clinic for revision surgery. Her chief complaints were an awkward appearance of the recipient area, wide face, and hyperfibrotic elevated scarring of the recipient site. The recipient site was treated with four sessions of triamcinolone injections. In total, 1112 grafts were placed to increase density in the recipient area and create a new hairline in the front and temporal peaks on both sides. The patient's midfrontal hairline area was awkward, containing too many two- and three-hair follicles. This area was redressed by placing many one-hair follicles in front in a zigzag pattern (Fig. 2).

Case 3

A 32-year-old woman visited our clinic with awkward results from two previous hairline correction surgeries performed 4 years earlier at another clinic. After three sessions of total laser hair removal of previously transplanted hairs in the frontotemporal recess area, revisional hairline correction surgery was performed to create a new hairline. In total, 1430 grafts were placed using the FUT method (Fig. 3).

Discussion

Female hairline correction surgery has gained substantial popularity and is now one of the most common aesthetic plastic surgeries performed in Asian women. Jung et al. [5] described the basics of hairline shapes and operation details in Asian women. Park and Moh [6] introduced a novel method of using hair transplantation to camouflage the

Table 1 Reasons for complaints after previous surgery

Complaint	Number of patients	%
Low density	233	94.7
Wrong hair direction or angle	132	53.7
Lack of homogeneity with native hairs	32	13.0
Too-thick hair placed in anterior hairline	44	17.9
Two- or three-hair follicular units placed in anterior hairline	24	9.8
Unnatural hairline design	102	41.5
Still too-high hairline or still too-wide forehead	36	14.6
Asymmetric hairline	29	11.8
Too curly or kinky hair	24	9.8
Recipient site pitting scar	19	7.8
Donor strip scar widening	17	6.9

Some patients had more than two reasons

Table 2 Corrective modality for each category of patient complaints

Complaint	Corrective methods
Low density	Increase density
Wrong hair direction or angle	1. Laser hair removal
	2. Newly created hairline in the front for camouflage
Lack of homogeneity with native hairs	Additional hair grafting in between transplanted hairs and native hairs for more gradual change in hair density, exit angle, and degree
Too-thick hair placed in anterior hairline	1. Laser hair removal
	2. New anterior hairline creation
	3. Punch extraction
	4. Electrical ablation
Two- or three-hair follicular units placed in anterior hairline	1. Laser hair removal
	2. New anterior hairline creation
	3. Punch extraction
	4. Electrical ablation
Unnatural hairline design	1. New hairline creation after laser hair removal in case of too-narrow forehead
	2. New anterior hairline creation in natural design in case of still too-wide forehead
Still too-high hairline or still too-wide forehead	1. New anterior hairline creation
	2. Forehead reduction surgery
Asymmetric hairline	
Too curly or kinky hair	1. Punch extraction of obtrusive hairs when not many seen
	2. New hairline creation to the forehead when not many hairs
	3. Consider laser hair removal when many hairs are present
Recipient site pitting scar	New anterior hairline creation
Donor strip scar widening	1. Scar revision
	2. Follicular unit extraction harvesting from surrounding donor area to place at strip scar
	3. Scalp medical tattooing

remaining posterior zygomatic arch protrusion after zygoma reduction surgery. Park [1, 2, 7] also described a method to achieve a natural-looking hairline design, the conceptual and surgical details of side-hairline correction surgery, and a novel concept and method of infratemple area hairline correction surgery.

The increasing popularity of female hairline correction surgery has resulted in a proportional increase in patients requiring secondary revision of female hairline correction

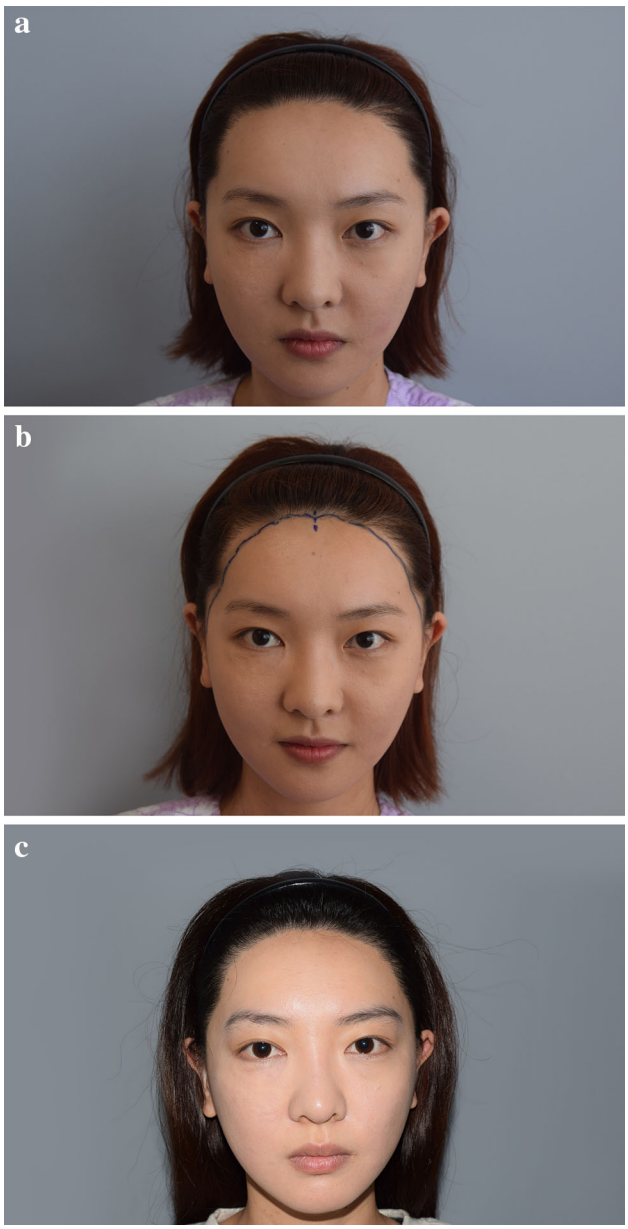

Fig. 1 A 28-year-old woman with a chief complaint of a wide, asymmetric, and awkward facial appearance after hairline correction surgery at another clinic 5 years earlier. **a** Preoperative photograph. **b** Surgical design. **c** Photograph taken 1 year after revision surgery

surgery. However, reports describing such revision surgery are currently scarce.

Secondary revision of female hairline correction surgery should not be approached as a simple correction of low hair density in the recipient area. Various complex factors need to be considered to achieve satisfactory results.

According to the authors' study results, additional strip surgery is not possible in some patients because of low scalp laxity resulting from previous surgeries. Such patients should be treated with the FUE method. If donor area shaving is not possible because of a patient's personal, occupational, or social needs, non-shaven FUE is recommended [8]. An optimal harvesting method should be applied with consideration of not only FUE and non-shaven FUE but also FUT to suit the various circumstances of different patients. To choose the optimal harvesting method, thorough evaluation of the donor and recipient areas is imperative at the patient's first visit. The patient's occupation, preferred hairstyle, age, and other factors should be considered before deciding on a surgical plan.

According to the authors' experience, the following eight points require attention in secondary revision of female hairline correction surgery.

First, the recipient site often has hyperfibrotic scarring. This scarring, when immediately followed by revisional hair transplantation, can result in excessive bleeding and popping and an ultimately low survival rate, leading to disappointing outcomes. Triamcinolone injections are helpful to soften the scar tissue prior to surgery [9]. Before surgery, it is also important to inform the patient of the possibility that a touch-up procedure may be needed due to the comparatively low survival rate and resulting low hair density.

Second, extra care should be taken because patients can often have problems at the donor site. Meticulous evaluation of the thickness, density, and distribution of donor hairs and of the scalp laxity, elasticity, and glidability in the donor area is imperative [10]. Specifically, preexisting donor scar widening has a high likelihood of rewidening even after scar revision [11, 12]. In such cases, the surgeon should consider FUE harvesting with extraction of additional grafts to place into areas of cicatricial alopecia resulting from the donor scar widening.

Third, patients may be satisfied with hairline shape, forehead size, and other features, but they may complain of a lack of gradation in hair thickness resulting from generally thick hairs. Such patients may require only a hair-thinning procedure with laser treatment instead of additional hair transplantation [13, 14].

Fourth, with the same hair thickness, multi-hair follicular units such as two- or three-hair units tend to look thicker. Therefore, both the FUE and FUT methods often involve splitting units into single hairs. These authors only perform ex vivo splitting; in vivo splitting is not preferred with FUE because it increases the transection rate. Single splitting is performed by the most experienced technician; it is best not to allow inexperienced technicians to perform single splitting. Of the harvested follicles, three-hair follicular units are divided into one- and two-hair follicles. Among the two-hair follicles, only those with some separation are split into single hairs; those with hairs very close together are excluded.

Fifth, the implanter technique allows more natural-looking outcomes than the slit method. However, the

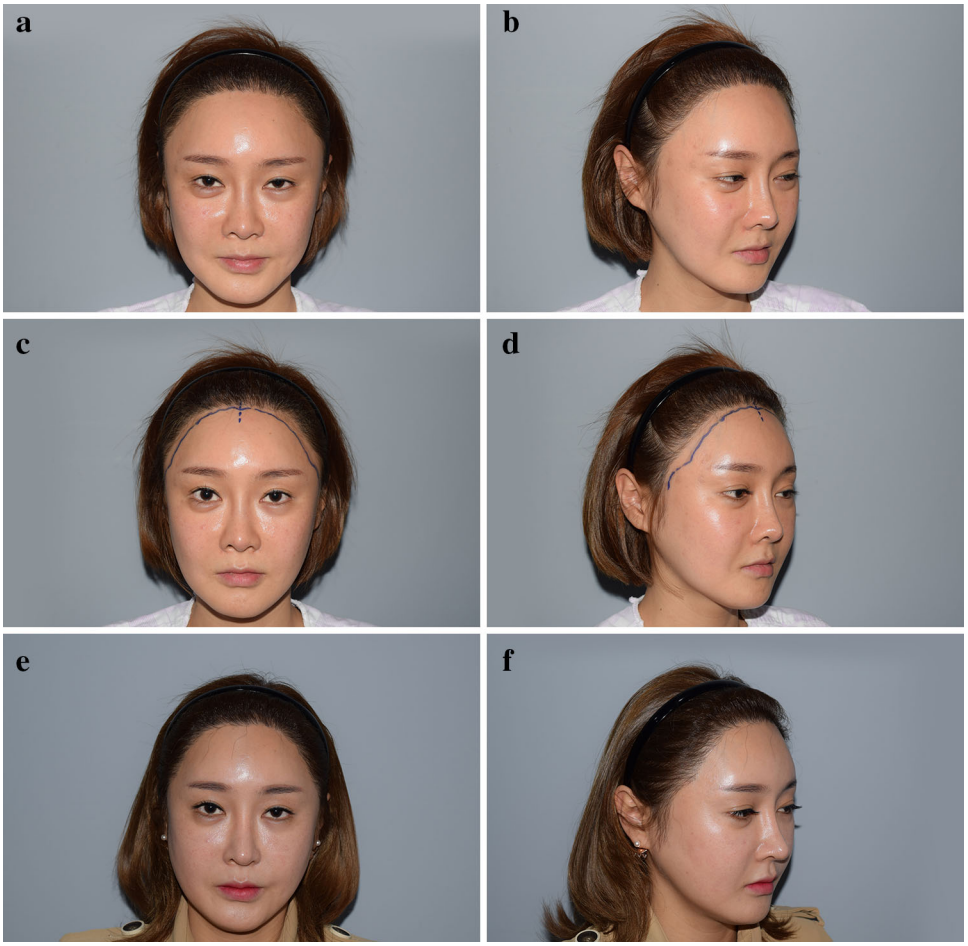

Fig. 2 A 36-year-old woman who underwent revision surgery after three prior hairline correction surgeries with unsatisfactory results. **a**, **b** Preoperative views. **c**, **d** Preoperative design. In total, 1112 grafts were placed with the non-shaven follicular unit extraction method. **e**, **f** Photographs taken 1 year after revision surgery

implanter technique can be problematic in patients with severe scarring and bleeding and can lead to graft popping. Graft insertion into premade incisions can be considered for such cases. The engraftment rate can be increased with rapid graft insertion and less trauma to follicles following incision using the implanter.

Sixth, the hairline should never be made straight because it will appear very artificial and unnatural [15]. A central peak must be placed in the midfrontal area, and temporal peaks must be present on both sides. When the patient genuinely has temporal peaks, the hairline should never be made into a straight line by filling in the areas above and below the peaks. This would lead to a typical doll-like appearance. Three or four small peaks are adequate between the central and temporal peaks per side. These peaks should be as irregularly irregular as possible. Peaks of the same size, shape, and interval will be noticeable, creating an unnatural appearance.

Seventh, thinner hairs can be harvested with the FUT method when the surgical design is made below the occipital area or is one-sided on the temporal side [16, 17]. When applying the FUE method, a meticulous distribution of hairs helps to create more natural outcomes; thinner hairs harvested from below the occipital or temporal areas are placed as far forward as possible, while those harvested from the midoccipital area are placed farther back [18].

Finally, hair-thinning laser treatment can be considered for patients with generally thick hairs. In the authors' experience, the frontal hairline becomes softer with a smaller hair diameter and lighter hair color [13, 14].

To these author's knowledge, there has not yet been, as of now, any study dealing with secondary female hairline correction surgery in the literature. Female hairline surgery and male hairline surgery, as two distinct entities, demand entirely different surgical indications, designs, and operative techniques. Therefore, to bring successful results in

Fig. 3 Revision hairline correction surgery performed after laser hair removal. **a**, **b** Preoperative photographs of revision surgery after three sessions of laser hair removal. **c**, **d** Preoperative design. **e**, **f** Photographs taken 1 year after revision surgery

female hairline revision surgery, the surgeon must apply an adequate repairing technique for each case based on a full comprehension of female hairline.

In this context, the authors' study results may provide some help to hair surgeons performing female hairline repair surgery.

All participants in this study were Asian with black hair.

Hair characteristics differ by race and culture; thus, different hairlines are preferred by different patients.

Not only facial shape but also social and cultural backgrounds would contribute to such difference.

Additional research and discussion of hairline correction in different populations should be conducted.

Conclusion

If secondary hairline correction surgery is performed with an awareness of the precautions mentioned above, satisfactory procedure results are anticipated.

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Compliance with Ethical Standards

Conflict of interest The authors declare that they have no conflict of interest.

Human and Animal Rights This article does not contain any studies with human participants or animals performed by any of the authors.

Informed Consent Written informed consent was obtained from the patients for publication of the case reports, photographs and any accompanying data.

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