Asian Female Hairline Surgery Using Follicular Unit Extraction

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Background Asian female hairline surgery is unique part among hair transplantation surgeries. Most of Asian female hairline surgery had been done by single strip harvesting technique which leave noticeable linear scar. As follicular unit extraction is introduced, female hairline surgery can take advantage of the Follicular Unit Extraction technique, leaving no linear donor scar. There has been a belief among surgeons who are somewhat reluctant to use follicular unit extraction for female hairline surgery that the inspection of the naturally occurring curl direction of hair, which is believed one of the critical steps for appropriate operative result in Asian female hairline surgery, is impossible in follicular unit extraction. So follicular unit extraction has to be 'plan B' in respect of Asian female hairline surgery. But author thought differently about this belief.

Methods From December 2012 to May 2013, 78 consecutive cases of female hairline surgeries were done by follicular unit extraction. The ages of patients were 18 to 57 and mean was 34.5. The cases can be categorized in 3 groups; 1) Correction of fronto-temporal recession only. 2) Whole hairline correction (including fronto-temporal recession, temporal recession and lowering of the central hairline). 3) Correction of the hairline with scar by previous aesthetic surgery just like forehead lift or forehead reduction surgery. Donor hair was harvested by follicular unit extraction and preparation of donor area was done by micro-strip shave pattern, by which no short haircut window was needed. Follow up periods were 4 months to 8 months.

Results Aesthetic results of the all cases were satisfactory. There were three cases which needed small session (less than 100 hairs) for relatively less survival area (all of these areas were the anterior part of hair part) and two cases of small 'moth-eaten pattern' on donor area which need no treatment or another session for aesthetic improvement. There was no lumpy graft which can be look unnatural or literal wall of plug graft in anterior part of corrected hairline. There was no linear harvesting scar, which is inevitable in single strip harvesting, on donor area.

Conclusions Follicular unit extraction can be versatile technique for hair restoration surgery and also hold good for Asian female hairline surgery.

Keywords Hairline surgery, Hair transplantation, Follicular unit extraction

INTRODUCTION

Hairline is central to a person’s appearance because it frame the upper one thirds of the face contour. Hair transplantation for hairline refinement or correction is the ultimate tool for achieving ideal and aesthetically desirable hairline.

Hair transplantation for hairline reconstruction is gaining popularity among Asian women with fronto-temporal recession or thinning, naturally occurring high hairline and aesthetically undesirable scar due to previous facial procedure (e.g. upper facial...
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Yi SJ

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lift surgery, forehead reduction surgery or forehead prosthesis insertion surgery). Modern hairline correction surgery can be categorized into two groups in respect of donor harvesting technique. One is the single-strip harvesting group and the other is follicular unit extraction group [1]. Single-strip harvesting is providing donor hair graft through incision in occipital scalp area and physicians harvest scalp tissue with hair follicles and then get individual hair grafts by dissection the hair follicles from surrounding scalp tissue. Precise control of graft dissection through direct visualization of the tissue was maximized using single-strip incision harvesting and stereo-microscopic techniques [2].

The only significant disadvantage to single-strip harvesting is the resultant donor scar. Even though most scar heals as a fine line, such a scar can potentially present cosmetic problems in certain cases. Additionally, single strip harvesting can sometimes be problematic in patients with very tight scalps where a primary closure is difficult and in the rare individual who heals with a widened scar.

Follicular unit extraction make circumvention the necessity of producing a linear donor incision scar possible. Follicular unit extraction can be recognized as variation of the punch technique which is based upon the pioneering work of Dr. Norman Orentreich [3]. However, Instead of using the punch to merely harvest 4 mm diameter-sized pieces of hair bearing scalp tissue, follicular unit extraction means directly extraction individual follicular unit from the donor scalp tissue without damaging the follicular unit structure, practically, providing hair grafts which are identical to those from single strip harvesting and stereo-microscopic dissection [2].

Follicular unit extraction has several advantages over classic single-strip harvesting:

1. Very small 1 mm wounds of follicular unit extraction which provide for rapid healing, leave an almost imperceptible donor scars, and offer a distinct advantage over the single-strip incision method which produce noticeable linear scar inevitably.

2. In the follicular unit extraction procedure, the surgeon can select which units to extract. Since hair follicles in the human scalp consist in group of 1-4 hairs not in randomly spaced individual follicles, one could choose only the large graft when trying to increase the density of recipient site, such as in the posterior part of hairline. On the contrary to this, for transition zone in hairline correction, the surgeon might select only thin single hair follicle.

3. Postoperative down time is relatively short in follicular unit extraction as compared with single strip harvesting. Additionally, office visiting in follicular unit extraction is less frequent than single-strip method.

But, even though these merits of follicular unit extraction make the proportion of the hair transplantation by follicular unit extraction increased among hair restoration surgeries, there has been a belief that follicular unit extraction can not be first option, at least, for Asian female hairline surgery. The rationale of this belief lies on, basically, the characteristics of Asian hair that its caliber is thicker than caucasian's ones. So the surgeon has to concern not only the insertion vector of graft but also inspection the naturally occurring curl direction of hair, which is almost impossible in the short cut hair follicle by follicular unit extraction, for aesthetically desirable and natural operative result. But author thought somewhat differently and will report about Asian female hairline surgery by follicular unit extraction. This report is the first literature about Asian female hairline surgery using follicular unit extraction in Asia.

METHODS

From December 2012 to May 2013. 78 consecutive cases of female hairline surgery were done by follicular unit extraction. The ages of patients were 18 to 57 and mean was 34.5. The cases can be categorized in 3 groups: 1) Correction of front-temporal recession only (17 cases). 2) Whole hairline correction (including fronto-temporal recession, temporal recession and lowering of the central hairline (49 cases). 3) Correction of the hairline with scar which came from previous aesthetic surgery just like forehead lift or forehead reduction surgery for whom with high hairline (12 cases). Donor hair was harvested by follicular unit extraction and preparation of donor area was done in micro-strip shave pattern, by which no short haircut window was needed. Follow up periods were 4 months to 8 months.

Surgical techniques

Preoperative consultation and design

Photograph and 3-dimensional scan

Preoperative photographs and 3-dimensional scans were taken for consultation and preoperative design. Preoperative photographs includes anterior view, both oblique lateral views (45 degree), oblique bird-eye view (Fig. 1A-D). Additionally author used 3-dimensional scan (Fig. 2), for consultation and preoperative design. The utility of 3-dimensional scan reside in that it make precise intuitional understanding of the contour of forehead and hairline status in 3 dimensional scale possible and this merits hold good not only for surgeons but also for patients themselves. Through photographs and 3 dimensional scans physicians can communicate with patients easily and prevent some misconceptions which could come from discordance of patient's expectations and surgical planning.

Preoperative hairline design

People who seek hairline correction surgery generally have particular desires, goals, and prejudices regarding their ideal hairline shape. Creating natural-looking hairline can be a difficult task be-
cause of the differences between a patient's expectation and ideal hairline design.

Hairline are as different as faces, so “ideal” is a relative and subjective term. Women who are not satisfied with their hairline often want their hairline to have a special character, such as the looks of some celebrities and simultaneously want delicacy and better-defined shapes. These differences in the preferences of each individual with particular perspective must be understood and incorporated in the design of the restoration.

Drawing the guideline (Fig. 3 arrow A) is first step of the design then, make both lateral mounds or peaks (Fig. 3 arrow B) along the guide line at the lateral of central prominence or Window’s peak (Fig. 3 arrow C). Design of temple area or temporal peak was done as occasion demands such as temple recession correction. Between lateral peaks, the areas of the low density implantation for very thin single hair grafts were marked for natural-looking hairline texture. Then photographs of the preoperative design were taken as same manner with preoperative photographs.

Anesthesia

2% lidocaine with epinephrine (mixed in 1:80,000 ratio) was injected along the drawing line and then tumescent solution, which consist of 2% lidocaine with epinephrine(mixed in 1:80,000 ratio) 40cc, normal saline 60 cc, and triamcinolone acetate 40 mg, was infiltrated for reducing of postoperative recipient site edema.

Slit creation

Slit creation was done by hypodermic needles and custom-made slit knives which were cut from razor blade (Fig. 4). 21-gauge hypodermic needle was used in the creation of slit for single hair follicle unit and 20-gauge hypodermic needle for 2 hairs follicle unit. Each hypodermic needle was angulated for appropriate slit depth and the depth was 7 mm to 9 mm depending on the length of each follicular unit. The slit knife was made by cutting the razor blade with the width of 0.72 mm to 0.78 mm for single hair follicle and 0.83 mm to 0.86 mm for 2 hair follicular units. The slit knife was usually used for relatively dense scalp on which slit creation with hypodermic needle could be difficult because of high resistance at
the point of cutting the epidermis level which could result in the unintended curved slit. Number of the slit creation were recorded according to the size of the slit for harvesting exact number of grafts.

**Donor preparation**

Donor site was prepared and shaved in the micro-strip shave pattern with the width of 2-3 mm which usually contain 1-2 follicular units and hair was cut in 1-2 mm in length (Fig. 5). The surrounding hairs of the each row were fixed upward by plaster for convenience of harvesting procedure. The incident angle of slit to scalp surface has to be as flat as possible and almost flush with skin, especially for temple area.

**Scoring and isolation (extraction) of follicular unit**

Scoring was done with electric motorized follicular unit extraction tool and several scoring tips of different diameters (0.8 mm, 1.0 mm, 1.1 mm, and 1.2 mm) were used in corresponding with hair caliber, hair follicle length and the patulous degree of the lower part of follicular unit (Fig. 6). Alignment the incident angle of
Fig. 6. Scoring for follicular unit extraction. Scoring was done with electric motorized follicular unit extraction tool and several scoring tips of different diameters (0.8 mm, 1.0 mm, 1.1 mm, and 1.2 mm) were used in corresponding with hair caliber, hair follicle length and the patulous degree of the lower part of follicular unit.

Fig. 7. Single hair follicular unit was inserted by micro-forcep guided by hypodermic needle (21 guage).

donor site was observed.

the punch and exiting hair is critical for producing intact graft. Scoring was started in low row and proceeded upward. Follicular unit resemble a small bundle of rice-sheaf gathered at the top and splayed apart at the bottom. So scoring depth should be limited to just beneath the dermis level otherwise, scoring procedure result in damage or transection of the lower part of hair follicle where the critical structure for the regeneration of hair exist. Scoring was used to cut only upper part of the way down the follicle then the remaining lower part was literally pulled from the scalp. Extraction site was applied with EGF-gel form® (Daewoong pharmaceuticals, South Korea) for promotion of secondary intention.

Follicular unit insertion

Insertion of the harvested follicles was done in two different way. Single hair follicular unit was inserted by micro-forcep guided by hypodermic needle (Fig. 7). 2-hair follicular unit was inserted by using Choi implanter. Insertion depth was precisely controlled for preventing postoperative complications; cyst formation, less survival rate, and dimpkr or tenting of the exiting hair site.

RESULTS

Aesthetic results of the all cases were satisfactory. Three cases needed small session by follicular unit extraction (less than 100 hairs) for area of relatively less survival of graft (all of these areas were the anterior part of hair part). In two cases there are small ‘moth-eaten pattern’ on donor area which need no treatment or another session for aesthetic improvement. There was no lumpy graft which can be look unnatural in the anterior part of corrected hairline. There is no linear harvest scar which is in-evitable in single strip harvesting on donor area. No cystic formation of recipient site or

Case 1
A 50-year-old woman who wanted hairline correction of fronto-temporal recession with temple reconstruction. 2,683 hairs were grafted and 21 and 20 guage hypodermic needles were used for slit creation. Follow up period was 4 months and donor preparation was done with micro-strip shave pattern (Fig. 8).

Case 2
A 25-year-old woman who wanted correction of whole hairline (correction of fronto-temporal recession, reconstruction of both temple areas and lowering central hairline). 3,217 hairs were transplanted and 21 and 20 guage hypodermic needles were used for slit creation. Follow up period was 5 months and donor preparation was done with micro-strip shave pattern (Fig. 9).

Case 3
A 24-year-old woman who wanted correction of fronto-temporal recession, reconstruction of temple area and lowering central hairline. And she wanted to camouflage the forehead scar which is due to previous forehead reduction surgery for lowering hairline which resulted in unsatisfactory outcome with aesthetically unacceptable scar formation. 2,944 hairs were grafted and 0.74 mm width slit knives and 0.86 mm width slit knives were used for slit creation because she had hard scar and dense scalp tissue. Follow up period was 6 months (Fig. 10).

DISCUSSION

Asian female hairline surgery has somewhat unique characteristics as compared with male hair loss surgery or Caucasian hairline surgery. Just lowering of the central hairline is most often required in Caucasian female hairline surgery for look younger. But, in Asian
female hairline surgery, not only lowering the central hairline but also correction of fronto-temporal recession for round hairline (because they believe fronto-temporal recession make facial contour masculine look) is of major concern. The correction of temple recession is another main requirement in Asian female hairline surgery for slender facial contour. So Asian female hairline surgery can be regarded as one of facial contouring surgeries, while Caucasian female hairline surgery is thought to be a kind of anti-aging surgery.

Asian female hairline surgery is also distinguished from hair transplantation for male pattern hair loss in many ways: design, insertion angle of hair graft, etc.

In hairline surgery, there are 2 different ways obtaining of donor hairs: single strip harvesting and follicular unit extraction. Single strip harvesting is easy to learn and it secure the intact of follicle during harvesting if properly done. The only significant disad-

Fig. 8. Case 1. A 50-year-old woman who wanted hairline correction of fronto-temporal recession with temple reconstruction. 2,683 hairs were grafted and 21 and 20 gauge hypodermic needles were used for slit creation. Follow up period was 4 months and donor preparation was done with micro-strip shave pattern. (A-D) Preoperative views. (E-H) Postoperative views. (I-J) Postoperative close views. Close views reveal no unnatural curl direction of implanted hairs even though implanted hair was 1 mm short cut by follicular unit extraction.
Fig. 9. Case 2. A 25-year-old woman who wanted correction of whole hairline (correction of fronto-temporal recession, reconstruction of both temple areas and lowering central hairline). 3,217 hairs were transplanted and 21 and 20 guage hypodermic needles were used for slit creation. Follow up period was 5 months and donor preparation was done with micro-strip shave pattern. (A-D) Preoperative views. (E-H) Postoperative views. (I-J) Postoperative close views. Close views reveal no unnatural curl direction of implanted hairs even though implanted hair was 1 mm short cut by follicular unit extraction.

Follicular unit extraction could be regarded as a variant of standard punch technique [3]. But follicular unit extraction is distinguished from standard punch technique in using very small (about 1 mm) punch. 1 mm scoring punch can extract intact individual follicular units directly from the donor area not in form of merely small pieces of hair bearing tissue as in punch technique. Punch depth of follicular unit extraction is different from that of standard 4 mm-sized punch technique [3]. Punch depth of follicular unit extraction is limited to upper part of hair follicle but standard punch technique made neatly encompassment all the way down to bottom of hair follicle.

There are several problems inherent in removing individual follicular unit with small punch. Any significant variation between advantage to single strip harvesting is the resultant donor scar. Although scar from harvesting usually remains as fine linear form, such a scar could present cosmetic and psychological problems in women who don't want to explain how they got a scar to hairdresser or in the rare individual who heals with a widened and hypertrophic scar. Strictly speaking, follicular unit extraction is not a scar-less technique and, in author's opinion, it is fair that follicular unit extraction should be regarded as a scar-spreading technique with almost imperceptible one not impossible one to find out. But through follicular unit extraction, circumvention the necessity of producing a linear donor incision which result in linear scar and, in rare case, could make widely stretched hypertrophic scar formation is clearly possible.
the incident angle of the punch and the exiting hair can result in graft damage or transection. So most care has to be given to the alignment the incident angle of the punch with long axis of hair follicle. Although it is now widely known that hair follicles in the scalp grow in naturally occurring groups of 1-4 hairs rather than as randomly spaced individual follicles [4], it is less well known that this grouping is not maintained to the way to the bottom of the hair follicle. Follicles is grouped on the surface of the scalp and splayed in the level of subcutaneous tissue level [1]. To visualize it another way, follicular units resemble a small bundle of rice-sheaf gathered at the top and splayed apart at the lower portion. The clinical implication of this is that a punch that encompasses a follicular unit from the surface to bottom result in amputation or transection of the splayed bulbs as it cuts through the deeper tissues. So scoring depth has to be limited to only just beneath of dermis level and the remaining lower part has to be pulled out to prevent unwanted damages of follicles.

One of the advantages of the follicular unit extraction reside in it's selectivity; follicular units can be chosen and excised on the basis of how many hairs they contains. One could select only the largest graft when trying to achieve the greater density, such as posterior part of the hairline. In contrast, for transition zone or most anterior part of hairline, the surgeon might select very thin single hair units.

A forementioned, follicular unit extraction has several merits; it's selectivity nature make sorting out the projected hair follicles directly possible which is impossible in the single strip harvesting, donor wound is as small as 1 mm and healed with secondary intention to almost imperceptible ones as compared with noticeable linear scar by single strip harvesting, no suture are required, and

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Fig. 10. Case 3. (A-E) Preoperative views. Arrow: scar due to previous forehead reduction surgery. Scar formation was aesthetically unaccept-able. (F-I) Postoperative views. (J-K) Postoperative views. Close views reveal no unnatural curl direction of implanted hairs even though implanted hair was 1 mm short cut by follicular unit extraction. Scar due to previous forehead reduction surgery was well camouflaged.
postoperative office visiting is required less frequently as compared with single strip harvesting. But, physician became somewhat reluctant when they made a attempt to follicular unit extraction for female hairline surgery, especially for Asian.

There had been a belief that naturally occurring curl direction of hair is as important as the insertion angle and direction of follicle in Asian female hairline surgery. Because Asian usually have thick and coarse hair most surgeons had believed inappropriate curl direction of implanted hair could result in unnatural hairline because thick hair can not be bended easily. And the follicle provided by follicular unit extraction is too short for inspection of the curl direction of hair. But author thought differently from this belief that insertion angle and direction is critical but naturally occurring curl direction is not. The reasons are

1. Even though suppose that inspection of the naturally occurring curl direction is important, the value is confined for only one directionally curved hairs. It means that for curly hairs, this inspection is impossible and for straight hair, inspection will make any different in the transplantation procedures.

2. The value of the curl direction inspection is just confined for anterior part of recipient site (because curl direction of posterior part of recipient site is hard to identify) where thin single hair is inserted. This thin single hair is more flexible than 2-hair follicle or thick single hair and bended easily to downward by gravity force.

3. Most of transplanted hairs are terminal scalp hair. It means that as it grow, it gain weight and can be bended easily to gravity direction and become easy hairstyling. If transplanted hairs were harvested from eyebrow or body hair it can not grow longer to gain enough weight for bending naturally.

Because of these reasons, operative results by follicular unit extraction didn’t reveal any unnatural curl of implanted hairs. And author can verify that the influence of the naturally occurring curl direction of hair to end result is, even if it were, very circumscribed.

As forementioned reasons, author believe that follicular unit extraction can be versatile technique for hair restoration surgery and also hold good for Asian female hairline surgery. Follicular unit extraction has several benefits: no linear harvesting donor scar, sorting out the projected hair follicle directly (e.g. 2 hair follicular unit only or very thin single vellus hair follicular unit, which is valuable when creating gradual increase of the hair thickness on anterior part of hair implanted area for aesthetically natural result, only), convenient postoperative management and relatively short postoperative down time. These merits make this technique gain popularity in the hair transplantation field and evolve into major method for hair transplantation surgery.

REFERENCES