

Reduction Foreheadplasty: For Reducing the Vertical Height of Forehead and Facial Proportion

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INTRODUCTION

A charming face often requires well-balanced vertical and horizontal proportions, when viewed from the side, the facial contour should be adequately augmented, making for a naturally convex curve [1]. The curve should be smoothly led to the scalp above the forehead leading up to the hairline without any depressed or protruding points. If one's forehead is broad, it gives the effect of a large looking fore-

Background A face is considered beautiful if the forehead is presented with a width and proportion similar to the golden ratio or so called Cannon ratio. The most previously performed plastic surgeries on the forehead was a procedure to fill depressed parts so as to make the appearance of a smooth but convex three-dimensional forehead. However, this study focused on making a beautiful facial contour from the creation of a forehead adequately proportional to the overall ratio through a method of correcting the large forehead.

Methods Based on the measurement by gliding test, start the designing in a zig-zag form along the hair line. Flap is dissected as designed between the galea aponeurotica and above the periosteum. In order to reposition and fix the scalp flap to the desired place, Endotine forehead® is used.

Results The amount of forehead reduction ranged from 12 to 23 mm, the average being 15.9 mm. The post-operative scar was matured 5 to 6 months after the surgery, and became faded and invisible in most of the patients.

Conclusions The method used by the authors may be referred to as a surgical method with an emphasis on reducing the area on the forehead directly. This was done by lowering the location of the trichion, shortening the length of the forehead, and consequently reducing the size of a broad forehead. Satisfactory results were obtained from the tension-minimized forehead reduction procedure used in this study.

Keywords Endotine, Esthetics, Forehead, Scalp, Surgical flaps

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head; the entire facial shape appears to look bigger and the individual tends to look older than his/her actual age. Thus, those who think their forehead is too wide or big try covering it with a hairstyle that includes bangs [2].

A face is considered beautiful if the forehead is presented with a width and proportion similar to the golden ratio or so called Cannon ratio. According to the tri-sectioning law of the face, a forehead with a vertical length (Measurements are taken from the midpoint of the forehead line from trichion to the glabella) that is one third of the total length of one's face is considered aesthetically beautiful [3]. Lee et al. [4] had reported that the mean length of Korean women's foreheads who won prizes from beauty contests were shorter than one third of her total facial length. When comparing the measured mean values for the faces of Korean women with the mean values measured from beauty pageant winners, the mean proportions of their foreheads were 1:0.8.

The most previously performed plastic surgeries on the forehead was a procedure to fill depressed parts with autologous fat injections,

inserting silicone implants or filler so as to make the appearance of a smooth but convex three dimensional forehead [5]. However, this study focused on making a beautiful facial contour from the creation of a forehead adequately proportional to the overall ratio through a method of correcting the large forehead. This was done by lowering the location of the trichion, shortening the length of the forehead, and consequently reducing the size of a broad forehead. For such purpose, the authors had used a forehead reduction surgery.

METHODS

Patients and pre-operative preparation

We had conducted the surgery in patients who thought their forehead was large. Ideal candidates for forehead reduction are those whose forehead line is high and round, with a shape that does not receding hairline from the frontotemporal side. The post-operative scar is likely less visible in the patients who have adequately mixed hairs of the scalp hair and down hair at the forehead line. An adequate quantity of hair would also be a good indication of forehead reduction.

Design

For a pre-operative design, it was confirmed that the redundance for the gliding test would be available by moving the scalp back and forth as the patient lie in the supine position and the reducible volume when the scalp is sufficiently lowered down forwardly is

measured by using a ruler. Based on the measurement, start the designing in a zig-zag form along the inside shape of the hair line and the zig-zagged triangle shaped flap is to be designed with a spacing of 1.5 to 2.0 cm ensuring it is not too small depending on the site (Fig. 1). If the zig-zag line is too small, it rather can be seen quite easily, causing the blood circulation to become poor due to the small flap, so it is likely a scar will be visible. It is good to position the incision line at the border side or a little behind the present hairline. If conducting the incision from too far behind, the transition site between thin hair and thick hair disappears, making the hair texture unnatural, therefore, requiring caution.

Surgical methods

Anesthesia

The procedure was conducted by a combination of local anesthesia and intravenous sedation. By using 1% lidocaine mixed with epinephrine at the ratio of 1:100,000, the anesthesia was done by blocking the nerves, such as the supraorbital nerve, supratrochlear nerve, greater occipital nerve and lesser occipital nerve along the rear nape line, the entire forehead and occipital areas. It was ensured to inject 0.1% buffered lidocaine sufficiently up to the posterior side of the vertex where the dissection was required including the skin segments to resect. Sufficient anesthesia makes dissection very convenient during the surgery, and minimizes bleeding. The entire face as well as even up to the scalp of the occipital area should be draped thoroughly aseptic using povidone-iodine solution and prepare the site of surgery by covering with surgical cloth.



Fig. 1. Preoperative incision design shows zig-zag form along the inside shape of the hair line.



Fig. 2. Incision should askew along the hair follicles, leave the hair follicles in order to hide the scars.

Incision

An incision is made a little behind the present hairline and made by using No. 15 and No. 10 blades along the line pre-designed before the surgery. If incising askew by inclining the blade along the hair follicles, leave the hair follicles so that the scars are hidden in the hairline (Fig. 2). When the incision is made after a pre-operative injection of epinephrine in the sufficient amount and with enough time going by, any serious heavy bleeding can be prevented. However, if hemostasis is conducted on a small bleeding site by using an electrocautery, it may cause injury to the hair follicles and cause the post-operative scar to be visible.

It is better to ensure the design and the incision line do not advance too much toward the temporal side, because an excessive temporal incision would leave a notable scar and it may not be essentially needed for the surgical techniques in many cases. An incision being made together with visual confirmation on intra-scalp hair follicles can minimize the scar that will be eventually enlarged due to hair loss after surgery.

Flap dissection

After an incision is made along the pre-designed line, the flap is dissected between the galea aponeurotica and above the periosteum. Dissection of the flap progresses toward the posterior side of the head. Here the frontal forehead flap is left without being excised, instead the scalp flap is advanced forward and fixed.

Continuous dissection is made carefully from the incision line toward posterior side of the head through the same layer between

the galea aponeurotica and the periosteum until obtaining a sufficient flap. Gentle dissection of the flap is made by using an elevator. The flap from the posterior side of the head is usually dissected up to the posterior part of the vertex (Fig. 3).

Repositioning and fixation

The flap is sufficiently irrigated with a saline before advancing and positioning it in order to ensure hemostasis of bleeding points and to prevent hematoma formation. The advancement of the entire flap to the desired position is confirmed by moving the flap smoothly forward with a little tension. In order to reposition and fix the scalp flap to the desired place, Endotine forehead® (Coapt Systems Inc., Palo Alto, CA, USA) is used (Fig. 4). When the tension is small, the closing suture is possible even without using Endotine®, but it is likely for the scar to enlarge due to eventual tension and the patient may complain of pain and sensory dysfunction as the scar begins to stretch out. Therefore, Endotine® is used in all cases. Two pieces of Endotine forehead® are set to the line of the pupil and fixed at a site distant from the forehead hairline, approximately 5 cm. The elevated flap is pulled forward for advancement as much as possible to cover the resected site, then it is fixed. If there is any part of the dissection that is not completely done, the flap is to be lifted again to complete the dissection and must be re-pulled. The completely elevated flap is repositioned by pulling it forward and secured by using Endotine® in the state as weak tension is applied evenly to the whole flap (Fig. 5).

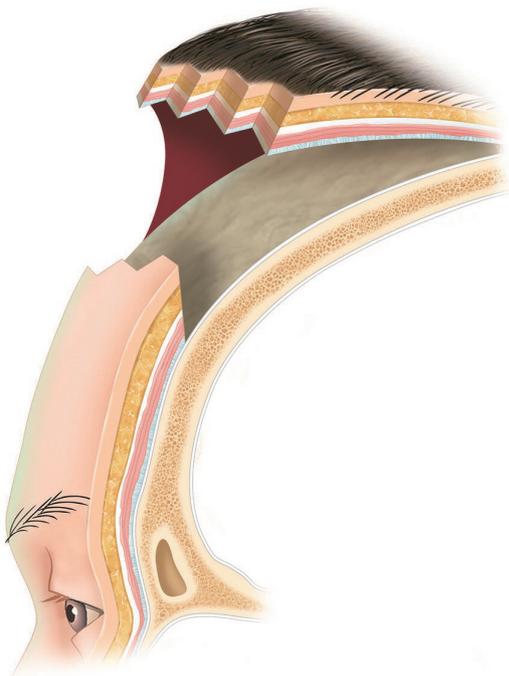


Fig. 3. The flap is usually dissected up to the posterior part of the vertex.



Fig. 4. Endotine forehead® is used in order to reposition and fix the flap to the desired place.

Closing with suture

After confirming that the scalp flap is made to the suture line without any tension, it was sutured to the galea aponeurotica using an absorbable suture Vicryl 3-0. After confirming a zig-zagged line has been abutted, suture was done in an interrupted suture method, using nylon 6-0. Separate drainage is not used because as the scalp of the forehead is in a reduced shape a certain extent of tension is being added. This tension ensures that there are few areas where the blood may be retained. Rather, if a drainage is used together with compressed dressing, it is likely to create concern for the formation of dead spaces. The surgery will be finished after sufficient and gentle compressive dressing is applied to the entire scalp.

Post-operative care

The patient who undergoes intravenous sedation is discharged after a few hours of observation and will be asked to visit the hospital the next day. On day 7 after surgery, half of the sutures are removed and then on day 10, the patient visits the hospital to remove the rest of the sutures. The patient should visit on 2 weeks and one month after the surgery for prognostic observations.

RESULTS

From June 2013 to June 2016, there are total of 156 cases which include 38 cases of man. When we measured the distance from the



Fig. 5. The flap is repositioned by pulling it forward and secured by using Endotine forehead® in the state as weak tension is applied evenly to the whole flap.

nasion to the trichion, it was 4.4 to 9.2 cm (the average being 6.4 cm) in all patients. The amount of forehead reduction ranged from 12 to 23 mm, the average being 15.9 mm. Almost of all patients were satisfied with the post-operative outcomes, but 1 patient was unsatisfied with outcomes, so received forehead reduction once more with 35 mm reduction finally.

In the surgery we had performed, there was no complications other than the incision scar, and due to the nature of the surgery, it is rare to have any dead space. So there was neither hematoma or seroma retention, or temporary or intermittent sensory dysfunctions. The post-operative scar remained reddened for 2 to 3 months, but the scar was matured 5 to 6 months after the surgery, and became faded and invisible in most of the patients (Fig. 6). However,



Fig. 6. Case 1. Preoperative and postoperative photograph 5 months after surgery. (A) Anterior-posterior (B) Right oblique view which shows faded scar along the hair line.



Fig. 7. Case 2. Preoperative and postoperative photograph 6 months after surgery. Discolored scar along the suture line is showed.

in patients with a darker skin tone, it should be noted that they needed to be informed about depigmentation of the scar. As a result, 3 patients were left with a discolored scar along the suture line after 6 months (Fig. 7). In addition, 1 patient received a hair transplantation along the scars on the suture line to hide the scar.

In 1 case, the Endotine®-secured part was palpated up to 4 months after the surgery as Endotine®-induced complication and there was a complaint of intermittent pain. So we conducted a surgery to remove them under local anesthesia. In this case, the Endotine® was secured in a partially absorbed form at month 4 after surgery. The secured and palpated parts were found and removed; thereafter no abnormality was found.

DISCUSSION

There had been many numbers of papers and presentations on forehead cosmetic surgery. In the past, the older ones were more interested in cosmetic surgery of the forehead as they focused on rejuvenation surgery of the forehead by removing wrinkles and lifting brow ptosis [6-10]. Lately, as people prefer to have a small and round face with a convex forehead, the younger generation also has come to prefer a more convex, smaller looking forehead [11].

Lee et al. [4] had presented that the mean proportion of forehead in beautiful women was 0.8 compared to the mid-portion of the face, which was smaller than 0.9 that was the mean value of Korean women recognized as beautiful which was shorter than one third of the total facial length.

A wide forehead can make the face not only look out of proportion but also look older. Therefore, when lowering the hairline at a higher level down in the forehead, it results in a facial shape with proper proportion and a younger look. For this reasons, Marten had advised that if the hairline gets higher in the outcomes of well performed forehead lifting surgery, it decrease the younger looking effectiveness of surgery, therefore the hairline lowering procedure techniques should be considered as keeping such an issue in mind [2].

As a surgical method for such interest in the past, such as the implant insertion method in which a pre-operative implant model was custom tailored for the forehead of an individual patient, or the method to augment the forehead through a autologous fat injection were often implemented. These methods are the procedures that add volume on a flat forehead so that it can be appear three dimensionally. But these methods are disadvantageous as they do not actually reduce the size of the forehead [5,12].

A hair transplantation method that directly lowers the hair line and reduces the size of the forehead has the same intention to those aforementioned. However, a hair transplant does not actually reduce the size of the forehead, instead it is just a kind of disguise for reducing visible parts of the forehead. This is one limit of the pro-

cedure; It also includes needing a lot of donor site in order to reduce 1 cm of the entire forehead, with long operating time and changing the little thin hairs at frontal head into thick hairs, which looks quite awkward, and so requires further correction through laser procedures which can be an inconvenience [13].

As described in the text, the method used by the authors may be referred to as a surgical method with an emphasis on reducing the area on the forehead directly. What should be noted for the pre-operative period or the operation period are that it is important to measure the amount of scalp that will be removed through the pre-operative consultation when making the preoperative design as customized depending on the hair line of the patient. For the measurement, the patient is placed in a supine position. When moving the forehead back and forth without adding any tension, the movement amount is measured. In such measurements, it is better to ensure that the heights of the facial mid-section and forehead are compared and the height of the forehead to be reduced is slightly smaller than the height of the facial mid-section. Based on above, the proper amount to reduce can be determined by comparing it with the amount from the actual gliding test conducted.

The surgeries performed by the authors did not display serious complications but did have the potential of a visible scar. All patients should be informed that a surgical scar is noticeable for 2 to 3 months due to its reddened state. 5 to 6 months after, the scar becomes less visible as it matures, and then as the hair regrows on the scar, it becomes almost invisible. A few patients represented hypoesthesia through incision line not the vertex of scalp, but all of patients were fully recovered until 9 months after. It assumed that injury of some of deep branch of supraorbital nerve can't influence the results.

Discoloration occurred for 3 patients among those who underwent the surgery in our hospital; the scar was lighter than their skin tone (Fig. 7). Since such discoloration can occur about 6 months after the surgery. Therefore, such matter should be informed to the patients who have a darker face color before the surgery and the surgery should then be performed accordingly. In addition, for the patients with severe fronto-parietal recessing of the hair line, it is difficult to shape the forehead at the fronto-parietal site to be round after a scalp reduction surgery. This matter was also informed to patients who had consultations on the reduction of the applicable area and were advised that the outcomes of a hair transplantation could be better for them.

When the tension remained in the flap among the patient wished to reduce as much as possible, even after using Endotine®, it was possible to help them by moving the flap and making a horizontal incision in the galea with a spacing of 1.5 to 2 cm. In such cases, each incision line helps the expansion of the flaps by about 1 to 2 mm. To reduce the post-operative scars, it is important to reduce the tension of the flap. Sufficiently wide dissection is necessary to reduce the tension of the scalp flap. If the scalp flap is sufficiently

elevated, Endotine® is only needed to stabilize the flap for 2 to 4 months when it is absorbed. When pulling and securing the scalp flap by using Endotine®, it is possible to perform suturing in the state with nearly no tension when suturing the galea aponeurotica layer by layer. It was also identified that the scars were not stretched, as there was no tension on the suture line for a few months during the follow up observation period [14].

During this particular forehead reduction procedure, the forehead line is moved forward to reduce the forehead- space while widely lifting the scalp flap of the site where the hairs are growing from the hairline. Although this method may leave a scar on the upper side of forehead, the design is utilized to suit the shape of a patient's forehead. The surgeon must first accurately calculate the reducible size of forehead through a pre-operative gliding test.

The surgeon operates the procedure that involves elevation of the scalp flap, lifting as much as possible to reposition it. By using this method, the tension of the flap that occurs later is minimized preventing the enlargement of a scar. Satisfactory results were obtained from the tension-minimized forehead reduction procedure used in this study.

CONCLUSION

The authors performed a forehead reduction surgery through an intra-scalp incision and widely flap dissection, which could make the flap minimized the tension and preventing the scar. 1) We had measured the optimal amount of reduction by carrying out a pre-operative gliding test, 2) had made the incision ensuring there would be no injury to the hair follicles, 3) and after dissecting the flap sufficiently, 4) secured the scalp flap firmly by using Endotine®. Good outcomes were obtained by minimizing the post-operative scar by lessening the tension of the scalp flap.

PATIENT CONSENT

Patients provided written consent for the use of their images.

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