The Upper Third in Facial Gender Confirmation Surgery: Forehead and Hairline

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Abstract: The upper third of the face contains 2 features that are particularly important for facial gender recognition: the frontonasoorbital region and the hairline. The supraorbital ridge, which determines the position and exposure of the eyebrows, is almost invariably more developed in the male than in the female. Surgical modification of the frontonasoorbital complex, considered a standard procedure in facial feminization, is reliable and predictable, and also delivers satisfactory results that are stable over time.

A prototypical male hairline has an M-shaped pattern compared to the more rounded shape often seen in female hairlines. Feminization of the hairline requires minimizing the temples as well as rounding out the overall shape, optimizing hair density, and occasionally changing the height of the hairline.

This article provides an update on our forehead reconstruction technique and our experience in the treatment of hairline redefinition.

Key Words: Facial feminization surgery, forehead reconstruction, hairline, forehead hairline lowering surgery, simultaneous hair transplant

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Forehead recontouring or reconstruction is the surgical procedure most described in the scientific literature for Facial Gender Confirmation Surgery (FGCS). Over the past few decades, new diagnostic tools have been introduced, such as computed tomography (CT) scan with 3D reconstruction, and numerous modifications have been made to improve the technique: recontouring the areas adjacent to the supraorbital ridge (forehead surface, frontomalar buttresses, orbital ridges, and frontonasal transition), the use of osteosynthesis materials (titanium screws, microplates, and meshes), the use of anchor systems for the scalp, and the introduction of new materials for use in cranioplasty (i.e., hydroxyapatite, polyetheretherketone, etc).

However, and despite the importance of the hairline in the recognition of facial gender, few authors have studied the treatment of the frontonasoorbital complex and the hairline together. In 2009, Shams and Motamedi described a surgical hairline lowering procedure in a trans female patient for the first time. Since then, only 1 scientific publication has proposed an alternative hairline treatment technique: forehead reconstruction and simultaneous hair transplant (SHT).

This article provides an update on our forehead reconstruction technique. It also gives a bibliographic review of the evolution of surgical techniques to feminize the forehead and treat the hairline (See supplemental digital content, Table 1-SDC, http://links.lww.com/SCS/A543), and compares surgical hairline lowering to a hair transplant.

METHODS

Study Design

Between August 2008 and September 2018 (122 months), we treated a total of 1049 trans female patients for forehead reconstruction, with the average patient age being 39.4 (range 18–73). Of these patients, 129 (12.30%) were only operated on for forehead reconstruction. The remaining 920 patients (87.70%) also underwent 1 or several of the following surgical feminization procedures: SHT and/or deferred hair transplant (DHT), hairline lowering surgery (HLS), rhinoplasty, malarplasty, lip lift, lower jaw contouring, or Adam’s apple contouring.

With specific regard to hairline treatment, 287 patients of the total number (27.36%) underwent SHT, 77 patients (7.34%) HLS, and 22 patients (2.09%) DHT.

Hair transplants were performed using the follicular unit (FU) strip surgery technique in either simultaneous or deferred transplants. All of the patients who received a hair transplant had clinical alopecic stabilization resulting from the hormone treatment associated with their gender transition beginning at least 1 year before their operation. As previously described, a modified coronal approach at the temporoparietal level (anterior) was the technique of choice for patients with Hamilton-Norwood type I, II, and III, good hair density (>60 FU/cm²), and a clinical and dermatoscopic absence of miniaturization. A modified coronal approach at the temporoparietooccipital level (posterior) was the technique of choice for patients with Hamilton-Norwood type III and IV, temporoparietal hair density below 50 FU/cm², and the clinical or dermatoscopic presence of miniaturization in the temporoparietal region.

From August 2008 to October 2014, all patients underwent preoperative and postoperative teleradiography and a cephalometric study. Since November 2014, all patients have undergone a preoperative and postoperative CT scan with 3D reconstruction (SOMATOM Emotion CT, Siemens, Munich, Germany). Pre-, intra- and
The results and images that appear in this article belong to patients who have given their express consent for their image to be published in scientific publications in compliance with current personal data protection regulations.

ANATOMICAL AND CLINICAL CONSIDERATIONS

When approaching the upper facial third in trans female patients, both the anatomy of the frontonasoorbital region and the overall condition of the hairline—format, height and hair density—should be considered as a unit. The frontonasoorbital region encompasses the forehead surface, the frontal bossing (the most prominent region of the frontal area) and the supraorbital ridge, the frontomalar buttresses, the temporal ridges, and the frontonasal transition. The supraorbital ridge, which determines the position of the eyebrows, is almost invariably more developed in the male than in the female. Typically, all of the areas are more pronounced and have greater bone volume in the male than in the female skeleton.

Regardless of gender, the hairline has a series of intrinsic characteristics:

- The first 2 or 3 rows of hair that comprise the hairline are made up of FUs with only 1 hair, followed by FUs with 2 hairs. This makes the hairline unique with respect to the rest of the hair.
- The hairline itself is naturally irregular, with randomly distributed hairs.
- There is vast variability in the format of the hairline, which is, moreover, usually conditioned by hormone phenomena related to gender. In the absence of these phenomena, the hairline is usually stable over time. However, changes in hair morphology, density, and the like can appear over the years as a natural consequence of the physiological phenomena of aging.

In terms of gender, the male hairline tends to have an M-shaped pattern with recessions at the temples. The hairline of women usually has a rounded shape; their hair is not normally affected by alopecia and, proportionally, the hairline implantation is higher in the center than with men.

FOREHEAD RECONSTRUCTION AND HAIRLINE REDEFINITION

Forehead Reconstruction Surgical Technique

Forehead reconstruction is one of the key procedures in facial feminization. It completely modifies the frontonasoorbital anatomy and helps to soften and feminize the patient’s expression. The surgical plan is devised to open the frontonasal angle; achieve an adequate backward position of the entire forehead, including the anterior wall of the frontal sinus, while maintaining a harmonic rounded shape; recontour the superior part of the orbit; and obtain a proper position of the eyebrows in relation to the new supraorbital ridge.

This article describes new developments with regard to the technique published by our group in 2014. At this time, a modified coronal approach (anterior or posterior) is used in approximately 93% of our patients (Fig. 1), regardless of whether or not they receive an SHT. The design of the pericranial flap and its careful dissection, preventing tears or perforations, is fundamental to guarantee the correct isolation of the entire surgical site, especially in the reconstructed sinus area. It is essential to identify and expose the key anatomical areas, which will serve as a reference point when the time comes to plan the bone remodeling and subsequent reconstruction. The working field is exposed, taking into account the identification and preservation of the supraorbital arteries, veins, and nerves.

In cases where there is some projection of the upper forehead region, an upper forehead setback procedure can be done before the osteotomy of the anterior wall of the frontal sinus. The aim is to make this area as leveled as possible with the insertion of the nasal bones into the forehead. After the bone shaving, the retropositioning needed across the entire frontoorbital ridge will become quite evident (Fig. 2).

The sequence continues designing the osteotomy of the anterior wall of the frontal sinus. This must take into consideration the anterior wall’s maximum projection, its thickness, the sinus length (cranial-caudal and lateral), the location and characteristics of the posterior wall of the sinus, the frontonasal angle, the location of the orbits with respect to the sinus, the intrasinus clinical situation, and the possible absence of a sinus. Most of these anatomical and functional considerations must be analyzed before surgery using a CT study (Fig. 3).

After the osteotomy, the next step is recontouring and setback of the frontoorbital region, using the following reference points for the bone shaving: the 2 frontomalar buttresses, the insertion of the nasal bones into the forehead, the orbital ridges, both temporal ridges, and the upper forehead region (with or without prior setback). With forehead that are especially square-shaped or have marked temporal ridges, correct exposure and shaving is essential in these areas. If a rhinoplasty is included in the treatment plan and when the nose insertion to the forehead is too high or projected, a conical burr is used to lower the frontonasal transition to the optimal and desired position, which will mark the level of the osteotomy or rasping of the new bony nasal dorsum during the subsequent rhinoplasty.

After completing the bone recontouring, work begins on repositioning the anterior wall of the sinus and fixing it using osteosynthesis material. This may vary substantially from 1 case to another according to the sinus characteristics (Fig. 4 and Fig. 5). During this surgical step, properly sealing the sinus is of particular...
concern, especially in the lower region or closer to the nasoorbital ridge, as is using the correct material to reinforce all the areas with obvious bone gaps, which have become excessively weakened after shaving or perforated.

The final surgical steps include suturing the pericranial flap, placing the anchor devices (Endotine Forehead-mini device, Coapt Systems Inc., Palo Alto, CA) to reposition the eyebrows in cases where this is required, and closing the surgical approach.

The sequence in Figure 6 gives a step-by-step description of the forehead reconstruction technique proposed by our team.

Simultaneous Hair Transplant Technique

This technique consists of taking advantage of the strip of scalp obtained during the modified coronal approach (anterior or posterior) used to access the frontal region, harvesting the hair follicles from the strip, and grafting them after the forehead reconstruction is done. Since it was published in 2017, the technique has undergone very few changes. Choosing the correct donor site based on hair density and absence of the phenomena of androgenetic alopecia and follicular miniaturization continues to be especially important. Additionally, attention must be paid to the transplant design in the hairline region in terms of the areas to cover and the drawing of the new hairline. This design must be marked before the forehead surgery so that it is not distorted by surgical manipulation.

RESULTS

The average follow-up time with the patients included in this publication was 58 months, with the interval ranging from 6 to 122 months.

Forehead Reconstruction

All the drainage devices could be removed between 24 and 48 hours after surgery.

The vast majority of the patients reported slight to moderate paresthesia in the forehead and scalp region, with spontaneous resolution beginning 3 months after surgery. A total of 43 patients (4.10%) required surgical drainage of a coronal hematoma in the first 24 hours after surgery. One patient had a cerebrospinal fluid
fistula that resolved spontaneously after applying posture measures. One patient developed sinus problems 2 months after surgery that did not respond to conservative measures, antibiotic therapy, or endoscopic treatment, requiring open surgery to clean the sinus and repermeabilize the frontonasal duct. One patient required a second operation to repair reabsorption in the orbitofrontal region that left a clinically visible defect.

**Simultaneous Hair Transplant**

Of the 287 patients who underwent forehead reconstruction and SHT procedures, an anterior coronal approach was used with
We believe that undulations and slightly beveled
in his 2011—
In our point of view, an endo-
results.

The average number of FU s per strip was 1508 ± 300, or some
The most commonly seen complications were the presence of
excessive scabbing in the recipient site (due to poorly hydrated
Figures 7–9 show different preoperative and postoperative

DISCUSSION
The forehead reconstruction technique has been widely described in
The forehead remodeling material. Villepelet et al, the last group to date to describe their

174 (60.63%), and a posterior coronal approach was used with 113
The average number of FU s per strip was 1508 ± 300, or some
mucosa.

thick bony septum. Raffaïni et al include a brow lift and lateral
canthal upper repositioning.\textsuperscript{1,5} With particular regard to reposition-
ing the eyebrows, we agree with the author that a coronal approach

14 In our point of view, an endo-

Dressing the hairline, in 2009, Shams and Motamedi argued

13 Focusing on the hairline, in 2009, Shams and Motamedi argued

28 Specifically, regarding forehead reconstruction, they reviewed the develop-
ment of the technique from the publication by Ousterhout in 1987 to
the article published by our surgical group in 2014.\textsuperscript{1,9}
Since 2014, several authors have published articles about their
experience with forehead reconstruction, presenting modifications to the technique. Bachelet et al use a piezoelectric scalpel for
the osteotomy of the anterior wall of the frontal sinus.\textsuperscript{15} We believe that
the vast majority of osteotomy cases can be safely and predictably
done using a standard reciprocating saw. The use of piezosurgery is
highly indicated for osteotomies on solid sinuses to prevent unwanted fractures or perforations in the posterior sinus wall.
Likewise, its use might be of interest when freeing the supraorbital
nerve in the event that its emergence is very high or when it has a

1.00 (SD 1.63). Procedures done: forehead reconstruction and simultaneous hair transplant; lower jaw contouring; Adam’s apple contouring.

Table 1

<table>
<thead>
<tr>
<th>Procedure</th>
<th>Number of Patients</th>
<th>Percentage</th>
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<tbody>
<tr>
<td>Forehead</td>
<td>174 (60.63%)</td>
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</tr>
<tr>
<td>Lower Jaw</td>
<td>1397 (44.23%)</td>
<td></td>
</tr>
<tr>
<td>Adam’s Apple</td>
<td>171 (57.88%)</td>
<td></td>
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Facial Gender Confirmation Surgery

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visible scar tissue and the complete loss of the naturalness of the hairline.

Based on the classification of hairline types in trans women described in 2017, we believe that HLS is contraindicated for patients with normal height and rounded format hairlines (Type I, 22%). In hairlines with normal height and receding side temples (Type II, 43%), HLS usually achieves greater lowering in the central portion, since the side areas, which have a different degree of recession, do not descend to the same level. As a result, there is some risk that the forehead will be excessively short in the middle region after surgical lowering. For patients with rounded and naturally high hairlines (Type III, 4%), HLS may be indicated. HLS and SHT can be considered for high hairlines with receding side temples (Type IV, 21%), which can be complemented with a DHT in a second session. Finally, for hairlines that are undefined due to advanced alopecia (Type V, 10%), we prefer SHT followed by a DHT or to leave it untreated.

One of the main risks associated with HLS is the possibility that it will leave a visible scar in a highly exposed location. At times, if the surgical wound was closed with tension, the scar can be considerably wide.

In conclusion, we believe that the forehead region and hairline are key elements in the feminization of the upper facial third. Fronto-orbital contouring with frontal sinus osteotomy and setback offers satisfactory and safe results regardless of the anatomy of the frontal region, even in patients with complete agenesis of the frontal sinus. Furthermore, SHT is a safe and effective alternative for treating the hairline.

ACKNOWLEDGMENTS
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