

## Laser-assisted hairline placement

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*\*The authors express financial interest in the product they intend to discuss.*

### Introduction

Hairline placement is important. It frames the face and has the most impact on a patient's appearance. The reconstructed hairline bears the signature of the surgeon, giving the first impression of his or her work quality.

Symmetry remains the first criteria in proper hairline placement. Differences in symmetry from one side to the other as well as differences in height impair facial attractiveness.<sup>1,2</sup> The shape of the hairline is also crucial. It should match the individual face to give the best aesthetic result. A monotonous "universal" bell-shaped hairline misses the artistic part of hair restoration.

Proper hairline placement can be very time consuming. The patient only sees the hairline after it is drawn and may not accept the design. The surgeon has to rub off the marking and repeat the whole process. Regardless the time spent during the consultation, it is difficult to record the exact hairline design on drawings or photographs. The entire procedure has to be repeated again on the day of the surgery.

### Use of Landmarks in Hairline Placement

As not every surgeon is gifted in drawing symmetrical curves, facial landmarks are commonly used to assist hairline placement.<sup>3,4</sup>

When drawing the frontal hairline, the glabella and lateral epicanthus are first projected vertically to locate the mid-frontal point (MFP) and the frontotemporal apex (Apex), respectively. A symmetrical curve is then drawn to connect these three points. Norwood advised resting the palm on top of the scalp behind the proposed hairline as the center point; drawing with a marker somewhat like a compass.<sup>5</sup>

For the temporal hairline, two pairs of landmarks are used to trace the nasal tip-pupil line (NTP line) and the MFP-tip of earlobe line (MFP-E line). The intersection marks the temporal point from which the superior and inferior temporal hairlines are created.<sup>6,8</sup>

In real practice it is difficult to project these 2-dimensional straight lines on paper onto a 3-dimensional surface; the lines bend significantly on the forehead. Flexible tape measure helps but cannot be totally trusted to reach the exact measurement on both sides.<sup>3</sup> Any slight deviation results in asymmetry. Better tools are therefore needed.

### Laser Level

In 2007, Shiao reported the use of a professional-grade laser level in designing a symmetrical frontal hairline and donor incision.<sup>7</sup> The patient was seated in an upright position. A laser level mounted on a tripod cast a horizontal plane of light that "turned corners" and followed the contour of the forehead or occiput. This provided a visual on the potential position of hairline and donor incision. A perfectly symmetrical guideline was instantaneously created.

The result was impressive; however, there are some practical problems in using a professional-grade laser level:

1. A large room is needed to tripod the device at a certain distance from the patient.
2. The patient has to be maintained in a perfectly horizontal position.
3. The head has to be tilted in different directions and angles to find the desired sloping of the guideline.
4. The level cannot create a feminine hairline in a normal sitting position.
5. The patient has to wear a protective eye-shield or glasses to prevent accidental laser exposure (see amendment).

Stimulated by Shiao's work, we have been working on a portable laser device that can overcome the above limitations. The first prototype was built in March 2008. The objective of this article is to introduce a handheld laser device that can assist in rapid hairline placement. The device made its first appearance at the ISHRS Asian Workshop in Korea.

### Material and Methods

The first model consists of a class IIIA horizontal beam laser module (3 volt, maximum power 5mW, 650nm wavelength) wired to a battery box. The assistant holds the device directly in front of the patient and casts a beam on the forehead. The surgeon tilts the patient's head in different angles to find and mark a curve most pleasing to the eyes. However, without the support of a tripod, two problems arise in the use of the handheld device: unsteadiness and tilting with the laser beam.

1. **Unsteadiness.** The device can be easily used to locate landmarks. To trace a line, however, is difficult. It is impossible to hold the device completely still. Slight tremor of the assistant's hands turns the projected thin line into jerky wave. Adding weight to the device and holding it in different ways are unlikely to maintain steadiness. Some kind of support other than a tripod is needed to maintain stability. We solved the problem by mounting the laser on one end of a 15 cm supporting frame (Figures 1 and 2). The other end of the frame rests firmly on the patient's forehead. By changing its position along the midline and angle of beam projection, different hairline shapes can be visualized. This new design also makes it necessary to maintain the patient in a rigid sitting position.
2. **Tilting.** When the laser beam is cast to join the glabella and the nasal tip, more than one possible centerline can be seen when the device is moved sideways. While 2 points can define a straight line in a 2-D plane; 3 points are required to define a unique projection in a 3-D setting. For this reason, we added the philtrum as the third point. Also, we replaced the single-beam module to a cross-beam laser. By aligning its vertical beam with the three mentioned points, a non-tilted horizontal hairline can be ensured.

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**Placing a Feminine Frontal Hairline**

The term "feminine" is used instead of "female" as this pattern can sometimes be desired by men. The feminine frontal hairline is characterized by an inverted U as opposed to the horizontal or upward U in the male pattern. The patient is seated in front of a mirror and asked to mark the lowest point of the desired hairline as point A (Figure 1). Its position is adjusted according to the age, budget, preference, and available donor hair. The centerline is then checked by aligning the vertical beam with the glabella, nasal tip, and philtrum. The intersection of the centerline and point A marks the MFP. The device is then positioned on the frontal region behind the MFP to cast a downward beam. Different shapes of hairline can be created by 4 simultaneous steps (Figure 2):

1. Moving the device along the centerline;
2. Tilting the device forward or backward;
3. Keeping the center of the crossed beam on the MFP;
4. Joining the lateral extension of the beam with the anterior border of the sideburns.

As the device is positioned above eye-level, the patient can actually look into the mirror to choose amongst the different visualized curvatures (Figure 3). The selected hairline is traced after it is inspected from different angles to ensure symmetry. For those requesting a round mound in the center, the device can be repositioned on the forehead to trace a second line (Figure 4).

The patient re-examines the completed drawing. The shape of the hairline is changed accordingly to suit the overall appearance. Finally, in order to create a natural looking irregular hairline, "macro-irregularities," "micro-irregularities,"<sup>3</sup> or "V" entrances<sup>6</sup> are added.



Figure 1. The patient sits in front of a mirror.



Figure 2. A feminine hairline in the shape of an inverted U is defined.



Figure 3. The patient provides immediate feedback about the hairline.



Figure 4. A compound hairline is defined.

**Placing a Male Frontal Hairline**

The centerline and MFP are first located in the same manner. The device is then positioned on the forehead below the MFP to cast a horizontal or upward beam. Different shapes of hairline can be created by three simultaneous steps (Figure 5):

1. Moving the device along the centerline;
2. Tilting the device forward or backward;
3. Keeping the center of the crossed beam on the MFP.

The selected hairline is inspected from the front to ensure symmetry, and from the sides to confirm that the lateral portions do not fall below horizontal.<sup>3</sup> The frontal hairline and the temporoparietal fringes can then be related in two different ways:

1. Connected with or without flare, or
2. Remain unconnected as a frontal forelock.



Figure 5. A male frontal hairline is defined.

On completion, symmetry of the apices is best checked by inspecting from behind the patient. Once again the laser can be used in a similar fashion (Figure 6).

**Temporal**

Existing vellous hair can guide to locate the temporal points.<sup>7</sup> For Mayer Class P and R, and those demanding a low frontal hairline, temporal hairline reconstruction is required. The laser device can be used either from a distance or positioned on the patient face. With the eyes closed, the NTP line and the MFP-E line are marked (Figure 7).



Figure 6. The symmetry of the apexes is checked from behind the patient.

Intersection of these two lines locates the temporal point (TP). The laser is then positioned along the centerline to confirm that both TPs lie along its horizontal beam. They should also be equidistant from the centerline. The superior temporal hairline is defined by drawing an up-sloping line from the TP and parallel to the nasal bridge. The inferior temporal hairline is defined by a down-sloping line parallel to the lateral eyebrow.<sup>6</sup>

**Eyebrows and Moustache**

The device is first positioned along the centerline to cast a horizontal beam. Onto the supraorbital ridges, the



Figure 7. A: The NTP line is defined. B: The MFP-E line is defined.

eyebrows uppermost points are checked. As the shape of an eyebrow is an inverted "U," the device should be positioned to cast a downward beam: the symmetrical lateral extensions trace the outer curvatures of the eyebrows (Figure 8). The moustache can be created in a similar way.



Figure 8. The eyebrows are defined.

#### Donor Site

Some patients demand revision of donor scars. They prefer to show a symmetrical wound when wearing very short hair. Scar revision, however, is difficult. Attempt should be made in marking a symmetrical strip in the first place. This can easily be achieved by using the laser device.

#### Other Applications of the Laser Device

The laser can assist in the classification of male pattern baldness. For example, in Norwood Type II, early recession in both temporal regions should be at least 2cm anterior to a vertical coronal plane drawn through each external auditory canal. This 2cm vertical line can be visualized with the laser for a more accurate diagnosis.

The device can also be used in other medical and cosmetic fields when symmetrical bodily parts reconstruction is required, such as eyebrow tattooing, nipple reconstruction, and forehead lift.

#### Discussion

Laser-assisted hairline placement is simple and time-saving in creating symmetrical hairlines. However, this is just a tool. No device can replace the human perception of beauty. At times, an asymmetrical hairline can be more natural looking. The surgeon's artistic judgment is still the most crucial in the design and placement of hairlines. Since the first prototype was developed in March 2008, the device is used in our daily practice on all patients. We are happy with the results and have become dependent on it. Modification and refinement have continuously been made, both in the device and the technique.

The advantages of using the laser device are as follows:

1. **Portable.** The device can be carried in a briefcase for use in our clinic, hospital, and operating theatre.
2. **Simple to operate.** It can be operated by just one person and no training is required. The device can be used regardless of the position of the patient.
3. **Affordable.** The basic components are simple and the device can be reused hundreds of times. The running cost is just the replacement of batteries.
4. **Less danger of direct exposure to laser.** The device is operated above or below eye level. The patient can open his or her eyes throughout the procedure and provide immediate feedback.
5. **Time saving.** We usually mark a symmetrical hairline in less than a minute. Time is further saved by reducing "draw and rub"; the patient visualizes and

accepts the design before the line is traced.

6. **Reproducible hairline design.** Three points identify one line in a 3-D setting. On recording three selected measurements (e.g., glabella to MFP, lateral canthus to apex), the original hairline can be retraced on subsequent visits.
7. **Individual design.** Traditionally, there is no rule how to shape the hairline. The surgeon simply draws an arbitrary curve according to his or her artistic imagination. On the other hand, the laser device describes a hairline predetermined by the individual facial contour. Every point along the hairline carries the same transit angle where the sagittal plane of the skull changes from horizontal to vertical. This is unique in each individual.
8. **Laser.** Patients are impressed just by hearing the word "laser."

The limitations of the laser device are as follows:

1. The laser beam loses sight amongst hair, thus, it is unable to outline a hairline on areas with plenty of existing hair.
2. Not all our tested laser modules can produce an accurate 90-degree cross-beam. Even a slight deviation can affect the overall symmetry of the described hairline. The beam calibration of each module should therefore be checked before use.
3. Aligning the vertical beam with the centerline is a good idea to outline a symmetrical hairline, as long as the facial contour is symmetrical. In some patients, the hairline placed using the normal protocol just looks out of place. The most likely explanation is an asymmetrical forehead. Under this circumstance, the vertical beam should best be ignored, or a single horizontal beam module is used instead.

#### A More Artistic Level of Hair Transplantation

Hair transplantation is also called Hair Restoration Surgery, with the objective to restore the patient's previous look before loss of hair. With the recent advance in follicular unit transplantation, we should be able to upgrade our work from restoration to enhancement. The patient can be more attractive than he or she ever was.

The perception of beauty follows certain patterns, depending on how the different parts (eyes, nose, hairline, lips) are proportionally positioned on the face. Da Vinci introduced the Golden Rule of Three. Greco has an excellent article in the use of "phi" and the "Golden Rectangle" to define the focal points. Art and mathematical principles can become part of facial framing and hair restoration design.<sup>10</sup> Pictures of celebrities can also be studied to search for the "pattern of beauty." The laser device can define landmarks instantly and facilitate the transfer of the complicated 2-D design onto the face.