Figure 14.15 **A 63-year-old female status post resection of malignant tumor of the scalp with bone involvement, underwent a craniectomy and methyl methacrylate reconstruction of the cranium and covered with a radial forearm flap reconstruction, one session of autologous fat injections was done to improve the conditions of the flap in preparation for hair transplantation, 6 months after the fat grafting she had the hair transplantation. Shown before and 6 months after the hair transplantation. Improved by simply framing her forehead with the new hairline, an additional session of grafting would enhance the final result by increasing the hair density.** (*Continued*)

Figure 14.15 (*Continued*) **A 63-year-old female status post resection of malignant tumor of the scalp with bone involvement, underwent a craniectomy and methyl methacrylate reconstruction of the cranium and covered with a radial forearm flap reconstruction. One session of autologous fat injections was done to improve the conditions of the flap in preparation for hair transplantation. Six months after the fat grafting she had the hair transplantation. Shown before and 6 months after the hair transplantation. Improved by simply framing her forehead with the new hairline, an additional session of grafting would enhance the final result by increasing the hair density.**

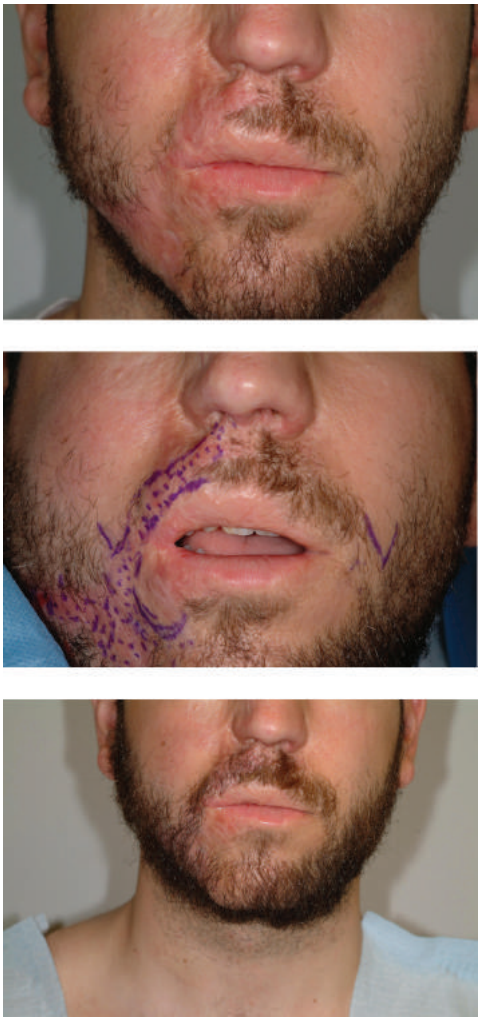

Figure 14.16 **Young man after third-degree burns around the mouth and chin on the right side due to accident in which his endotracheal tube caught on fire while having an electric procedure in a hospital. Shown before and a year after a single session of follicular unit hair grafting.**

DISCUSSION

It is much more difficult to work on some of these cases because of the severe degree of scarring and fibrosis. Obviously the graft take is less in those areas when compared to nonscarred areas.

In nonscarred areas the graft take may be up to 95%, of course, dissecting the grafts accurately and handling them atraumatically. On scarred areas this is a bit variable, generally around 60%, and we try not to densely pack the grafts as that in itself may reduce the graft take. Usually about 20–25/cm^2 per session will be transplanted.

It is very important to give realistic expectations to the patients and be certain they understand it will require several sessions for the most optimal result.

Hair grafts come with some fat cells and likely some stem cells; I have noticed that the grafted areas become healthier, softer, and thicker after hair transplantation.

CONCLUSIONS

In the patient with sufficient donor hair supply, follicular unit hair transplantation can safely and predictably enhance aesthetics in the reconstruction of the face and scalp.

Figure 14.17 **An 11-year-old boy with scarring alopecia of the left eyebrow due to resection of a melanotic lesion. Shown before and after a single session of follicular unit grafting.** (*Continued*)

Figure 14.17 (*Continued*) **An 11-year-old boy with scarring alopecia of the left eyebrow due to resection of a melanotic lesion. Shown before and after a single session of follicular unit grafting.**

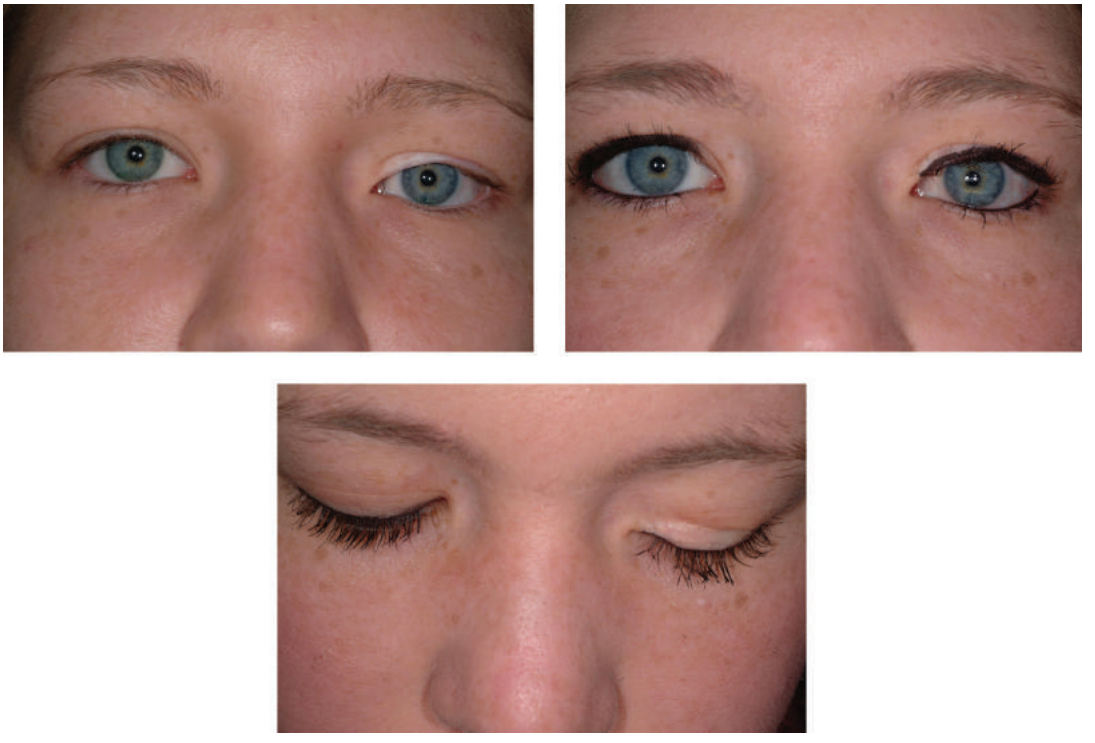

Figure 14.18 **A 14-year-old girl after resection of a hemangioma of the left upper eyelid with loss of eyelashes. Shown before and a year after a composite strip scalp graft to the eyelash.**

Figure 14.19 **A 43-year-old man after resection of a sarcoma of the maxilla and radiation therapy to the area and neck. Autologous fat grafting after 6 months follicular unit grafting, shown before and a year after the hair grafting.**

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15 Hair Transplantaion for aesthetic surgery of the scalp and body hair

Pierre Bouhanna and Eric Bouhanna

INTRODUCTION

In recent years, aesthetic surgery for male and female androgenetic alopecia or scarring alopecia has benefi ed from considerable progress. A diversity of techniques on the one hand, and a better assessment of their reliability on the other hand, allow surgeons to better focus their operations.

This surgery, which we limit here to hair transplant, obeys one overriding technical principle: the harvesting or preparation of autologous forms of micrografts or follicular units. Three techniques—mainly related to their sampling method—will be discussed here (follicular unit transplantation [FUT], follicular unit extraction [FUE], follicular units for long hair [FUL]). Automatic FUE transplanter or robotic FUE would be used for some indications.

Their indications are essentially guided by many parameters such as the area and the location of the alopecia; the sex, age, and ethnicity of the patient; characteristics of the scalp and hair; and the degree of alopecia evolution. A dynamic multifactorial classification combining all these parameters facilitates the choice of a suitable treatment for each case. A macrophotographic analysis or digitalized phototrichogram will implement this preliminary assessment.

FOLLICULAR UNIT TRANSPLANTATION

History

- In 1930, Sasagawa[1] reported the original hair transplantation method.
- In 1939, Okuda[2] mentioned for the first time the principle of autografts for the surgical correction of alopecia of the scalp, eyebrows, and mustaches.
- In 1943, Tamura[3] described pubic reconstruction in women with a one-hair transplantation.
- In 1953, Fujita[4] reported an eyebrow reconstruction puncture hair transplant among lepers.
- In 1959, N. Orentreich[5] published a method of harvesting cylindrical autografts with a cylindrical scalpel 4 mm in diameter (a "punch"). This process, which has prevailed for 25 years for the surgical treatment of male baldness, included some negative elements that led to its being neglected, such as an unsightly and unnatural appearance of tufts ("doll hair") and unsightly scars round "bees' nests" on the occipital donor area.
- In 1976 Bouhanna and Nataf[3,6,7] published a sampling technique for a graft trip procedure.
- Marritt[8] in 1980 proposed the use of micrografts for finishing earlier frontal hairline.
- Bradshaw and Limmer[9] in 1988 developed the anatomical concept of follicular units by cutting strips for micrografts (follicular unit transplantation [FUT]).
- In 1989 Bouhanna[10] published the technique of follicular units with long hair, by cutting strip under stereomicroscope without prior shaving (FUL).
- In 2002 Rassman and Bernstein[11] published the process of follicular unit extraction (FUE) with sampling with a microcylinder after prior shaving.

Principles

The main principle is to prepare micrografts or follicular units of one to four hairs:

- By follicular extraction[12] with a micropunch (by hand or motorized) of less than a millimeter (FUE).
- By follicular segmentation using a stereomicroscope of a strip of unshaved scalp (FUL)[10] or of shaved scalp (FUT).[9]

An essential point is that hairs harvested from the occipital region in men and the median occipital region in women keep their ability to grow definitively further once implanted on the bald or sparse area.

The goal

This process wishes to recreate the natural emergence of one to four hairs (the "follicular unit") through each pilosebaceous orifice (Figure 15.1):

- For the final transplant for bald areas of the scalp in a man, woman, or transgender in order to give the area an aesthetic and natural appearance.
- To blur some apparent scars (post-facelift, post-radiotherapy, after burns, stabilized pseudopelade, etc.).
- To make some hairy areas denser (eyebrows, eyelashes, beard, mustache, pubis).

Figure 15.1 **One, two or three hairs (a "follicular unit") emerging through the same follicular orifice.**

Preoperative stage

A delay of 15 days between the consultation and intervention is required before any act of cosmetic surgery with complete information and the signed consent of the patient.

Medical photographs are always performed for the face—profile view, aerial view, and the surface to be implanted.

A digital phototrichogram is obtained of the donor area implementing the measurements of the multifactorial classification.

Preoperative blood tests and an electrocardiogram are routinely prescribed.

Drawing the anterior frontal hairline

A preliminary sketch with a dermographic marker delimits the area to be transplanted with the consent of the patient in front of a mirror (Figure 15.2).

In women, androgenetic alopecia usually allows a more or less hairy frontal line to persist.

In men, androgenetic alopecia determines a more or less complete recession from the frontal line.

The first stage of the design is one of the important aspects of reconstruction for frontal male alopecia. It takes into account several factors with a particularly harmonious equation between the aesthetic requirements, age, and ethnic peculiarities of the patient on the one hand and the hair capacity of the donor area, the characteristics of the hair, and aesthetic values on the other hand. ("Il disegno e una cosa mentale," "design is a process of the mind"—Leonardo da Vinci.) A previous photograph of the patient from a few years earlier may be helpful. The frontotemporal recession will need to be more or less deep and the frontal line more or less rounded and more or less symmetric, with some irregularities.

Local anesthesia

The preparation, disinfection, and anesthesia of the donor and recipient areas are similar to those used for the dermatologic surgery. Disinfectants based on flammable alcohol should be avoided on the scalp.[13,14]

Anesthesia of the scalp is obtained by

- A local anesthetic all around the bald or hairy surface to be treated by intradermal infiltration of 1% lidocaine with epinephrine. The addition of bicarbonates makes these injections painless.
- A nerve block infiltration of the frontal and occipital nerves. The prior application of EMLA® (lidocaïn-prilocaïn cream) cream could make these injections virtually painless.
- A premedication with Valium decreases the anxiety.

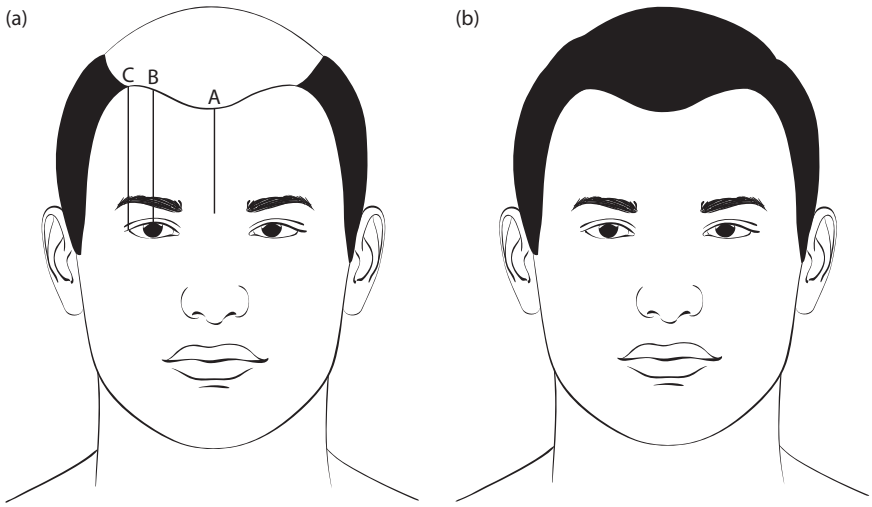

Figure 15.2 **(a,b) Schematic designs of the frontal hairline.**

- Sometimes the inhalation of a nitrous oxide gas (Kalinox–nitrous oxide) and a hypnosophrology session provide significant sedation in anxious patients.

Technique

Follicular unit transplantation (FUT)[18,20]

After a preshaving of the donor area, the conventional technical progress of removal of a strip and its segmentation into follicular units is then strictly similar to that of FUL described below.

Follicular units for long hair (FUL)

The hairs are not shaved and are therefore harvested with their stem length (Figure 15.3).[10,13,14,16]

The FUL technique we have described and refined since 1989[10] allows the removal and transplantation of grafts of varied shapes and sizes with long hair.

Without shaving the donor area, the strip will be segmented and taken under a stereomicroscope onto micrografts or follicular units with long hair.

The FUL process allows the patient immediately after surgery to mask scabs of the grafted area and thereby avoid a source of postoperative aesthetic embarrassment (Figure 15.4).

These long hairs will have two possible developments:

- The normal hair loss occurs for all or some of the transplanted hair in the third week, and regrowth occurs 3 months after surgery.
- All or part of the hair is still growing, eventually stimulated by medical prescriptions such as minoxidil lotion[17] or finasteride tablets[18] or platelet-rich plasma intradermal injection (PRP).[19]

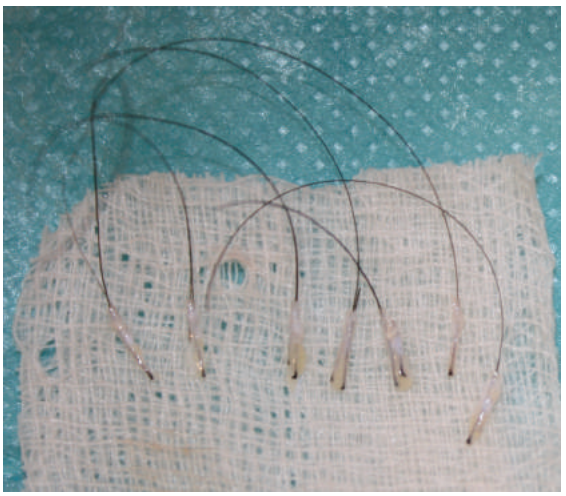

Figure 15.3 **Follicular units for long hair (FUL) after segmentation under a microscope.**

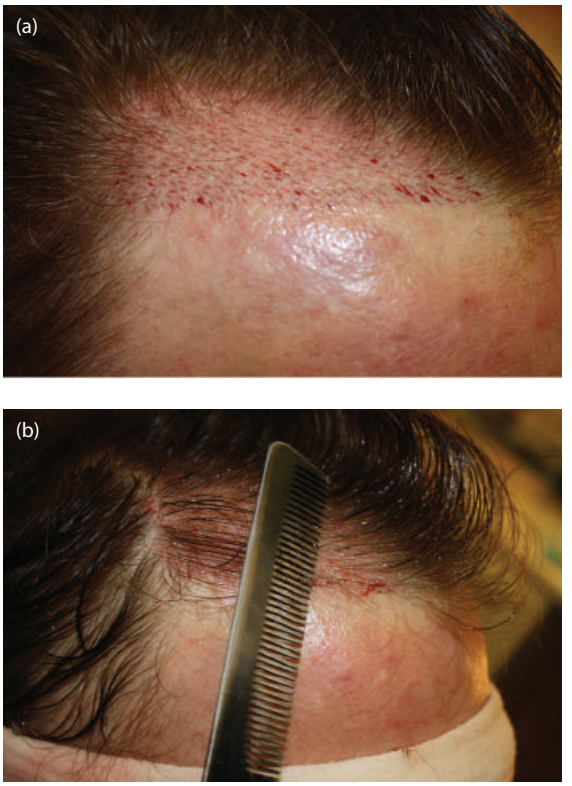

Figure 15.4 **(a) Frontal hairline with multiple microincisions. (b) Immediately after insertion of FUL, the new implanted hair is combed.**

Donor area: Preparation of follicular units. The strip removal of the unshaved occipital donor area previously infiltrated with saline is done by excision with a scalpel blade no. 11. The strip is about 10–30 cm long and 10–20 mm wide: the size depends on the desired number of follicular units[20,21] (Figure 15.5) and on the scalp laxity.

The closure of the edges of the donor area will be made with a resorbable suture with 3/0 thread or with skin staples (Figure 15.6).

Figure 15.5 **Strip harvested with long hair.**

Figure 15.6 **Running absorbable suture for closure of the donor area.**

The strip graft is placed on a gauze in a Petri dish containing saline and then placed on a frozen container. The segmentation is performed by cutting the pieces on a wooden tongue depressor with a no. 11 blade or blades with large microtomes. One to four assistants cut the strip of scalp onto follicular units, under a good light and using magnifying glasses or stereomicroscopes (Figure 15.7). Cutting will be parallel to the bulb in the strip, held with fine forceps by the epidermis in variable portions according to the number, size, and shape of grafts required.

On average 500–1500 grafts (1000–4500 hairs) will be cut, and each element will be cleared of all hair shaft fragments or hypodermic debris before being placed in the receiving tray filled with chilled saline solution.

Preparation of the recipient area. During this cutting, the operator prepares the anesthetized recipient area with perforations and incisions.[8,16,21]

This step of perforation varies according to different physicians.

Most of them do a perforation of the skin surface with a Nokor needle of 16–18 gauge or ophthalmic microsurgical blades (spear point or chisel) (Figure 15.8).

Others use a drill with small punches of 1 mm in diameter, operated by hand or by a motor punch.

Implantation of the recipient area. Most authorities handle the skin fragments using unteeth forceps, very fine jeweler's forceps, or forceps with curved ends; others prefer straight tweezers (Figure 15.9).

Each follicular unit is delicately positioned to its full height in the clamp and threaded through the skin surface that has previously been perforated or incised.

Currently, it is possible during a session to transplant up to 1500 follicular units. When rebuilding a balding frontal region, the fragments selected to achieve the end

Figure 15.7 **Segmentation of FUL under a stereomicroscope.**

of the line will be one hair (the puncture needle is a no. 18 gauge, intramuscular needle or microsurgical spear point) on the first row, then two or three hairs on the other rows (Nokor no. 18 gauge or chisel microblade).

Figure 15.8 **Hardware needed for surgery: needles and microsurgery blades.**

Figure 15.9 **Microsurgical forceps (straight or curved) for insertion of grafts.**

With a magnifying glass helmet, transplants are checked to control the correct insertion and proper orientation, or to swap some of them.

The patient should remain lying down for 1 to 2 hours.

The advantages of FUL are

- For the patient:
  - The donor area of micrografts is unshaved. So the harvested donor area is immediately hidden by long hair.
  - The patient sees immediately the result, even though all or part of the hair can fall out in 2–3 weeks; the policy of "wait and see" has been replaced by one of "see and wait." Note the positive effect in the case of minoxidil and/or finasteride and/or PRP.
  - The scabs that persist for 10 to 12 days are hidden by long hair. Thus, the patient can quickly resume professional and social activities after 24–48 hours.
- For the physician:
  - A better assessment of the direction and angle of the hair (Figure 15.10).
  - A better choice, especially at the frontal hairline and whether hair is thick or thin, dark or light.
  - As for FUT a large amount of hair can be harvested with FUL at each session (4000 hairs per session).

The main drawback of the FUL technique, as for conventional strip harvesting (FUT), is be that it sometimes

Figure 15.10 **A frontal region grafted with FUL allows a better choice of orientation, size, and color of hair.**

leaves a fine scar line. To avoid this it is possible to do a "trichophytic technique." This consists of removing about 1 mm of epidermis at the bottom edge of the excision of the strip. The hair will be able to grow through the epidermic and upper end to reduce the scar line edge. This method is borrowed from the "subepidermal technique" we described with Nataf for the front edge of the flaps for frontal reconstruction.[7,15]

If the patient wants for personal reasons to shave his scalp and the fine scar line becomes visible, it is very easy to transplant in a second time a few follicular unit extraction (FUE) or to do an easy dermopigmentation (see Chapter 17).

Follicular unit extraction (FUE)

Follicular unit extraction (FUE) consists of a preliminary shaving of the donor area and then raising follicular units with the use of a punch (0.7–1 mm in diameter) at the occipital and temporal donor areas.[11,22,23]

Although the quality of the sample is directly dependent on the experience of the operator, improvements on the instrumentation have increased the speed of withdrawal and significantly reduced the loss of follicular units per transection.

Technique. The harvesting area region is shaved (Figure 15.11). On average an area of 100 cm^2 (20 × 5 cm) can provide usually 500–1500 follicular units.

The procedure is performed under local anesthesia.

The position of the patient during graft harvesting is the lateral or prone position. For the prone position a specific prone-pillow is used to ensure adequate comfort.

The basic principle of follicular unit extraction is to make, using a punch, a section around the follicular unit by a rotation across the dermal layer. Once after realizing a section of hair arrector muscle, the follicular unit can be extracted with forceps.