

Chapter 6

What You Need to Know About Hair Transplantation



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Physicians in different specialties are sometimes asked questions about hair transplantation (HT). Patients are looking for answers to help decide if they are good candidates, where to go, what area to treat surgically, and what method is best to achieve natural long-lasting results. This chapter is intended to educate and inform physicians so that they can provide patients with informed answers to these questions. For further reading, it is helpful to refer to the textbook used by most hair transplant surgeons [1]. Within the field of hair restoration surgery, there are differing opinions regarding many issues. When possible, the author will also attempt to outline differing points of view, provided they are still sound and reasonable.

Overview of Terminology

This is not an exhaustive list of terms but will help readers to understand the following discussion and become familiar with the language most commonly used in the field of HT:

- Recipient area – the area of alopecia or future alopecia that is to be treated during surgery.
- Follicular unit (FU) – one to five hairs with associated sebaceous glands that are contained in a grouping bound by adventitial tissue, evident from the skin surface to the insertion of the AP muscle [2].
- Follicular family – two FU that are so closely associated that they can be transplanted as one graft and placed into one recipient site incision.

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- Follicular unit excision (FUE) – harvest method using a small punch to excise one follicular unit at a time from the donor area. Each area of extraction leaves behind a small punctuate scar.
- Elliptical excision/strip – harvest method in which an elliptical excision is used to remove the donor hair. The tissue is then divided under microscopic dissection to produce the follicular units. The excision is surgically closed and leaves a small linear scar.
- Donor area – the region with *relatively* permanent hair, from which the hair is removed for transplantation.
- Safe donor area – also called by FUE surgeons the “major region.” This is the safest region in the donor area for harvesting grafts. Hairs in this area are the most permanent on the scalp. FUE surgeons also define a minor region which includes hairs closer to the nape of the neck and other areas superior and inferior to the major region. Hairs in these areas will last for less of the patient’s lifetime [3].
- FUE punch terminology – there is an entire chapter sometimes dedicated to this topic. In brief, there are sharp, dull, and hybrid punches. Excision is achieved with rotation, oscillation, and/or vibration. The punch diameter may be defined according to internal diameter that reflects the size of the tissue removed or the external diameter that reflects the size of the defect left behind in the skin (the scar) [4].

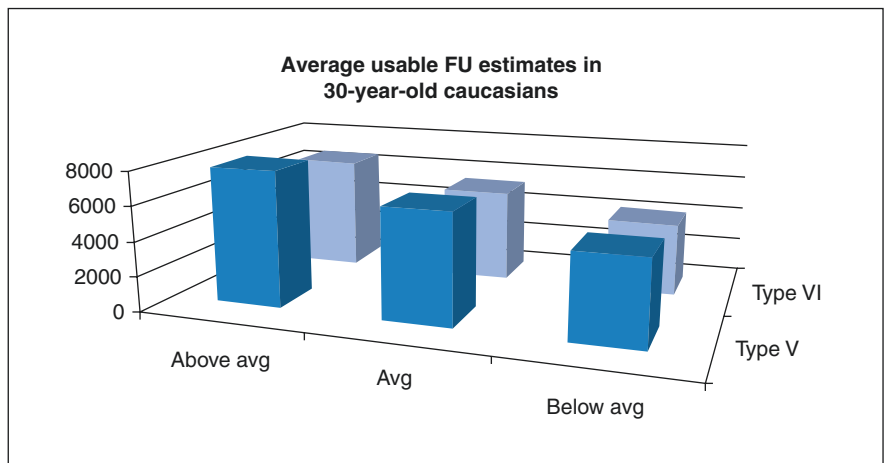
Candidacy

The question of candidacy is perhaps the most important. It is easiest to start with which patients are *not* very good surgical candidates:

1. Patients with active dermatopathology causing alopecia – including scarring and nonscarring alopecia. Most importantly, LPP and FFA may recur at any time and would affect the transplanted as well as pre-existing hair [5].
2. Patients with nonscarring alopecias like alopecia areata, active telogen effluvium, or anagen effluvium should ideally wait for resolution. The main reason for excluding surgery for patients with nonscarring alopecia is that it may be unnecessary. The second reason is that it is impossible to be accurate in surgical planning when the doctor does not know what the patient will look like after recovery from their temporary hair loss. Third, it may affect the donor area, and if the donor is harvested using a strip method, some tissue with dormant hair follicles may be discarded as alopecic.
3. Patients with very limited donor hair and a large alopecic recipient area *and* unrealistic expectations. The author adds this third requirement because even patients with a poor donor:recipient ratio may find that hair transplantation at least produces enough hair that certain styling options can be used to cover untreated areas [6].
4. Patients with diffuse unpatterned hair loss including the region normally used for donor harvest.
5. Patients on clopidogrel who are unable to stop use for the surgery.

Surgical Planning of the Recipient Area

The recipient area in hair transplant surgery refers to the areas of current AND future alopecia. The supply of donor hair over the patient’s lifetime is the limiting factor in most cases (Fig. 6.1). A responsible hair transplant surgeon will assess the patient in consultation and take into consideration their age, degree of miniaturization, and family history to determine what can be achieved with surgery and how many surgeries might be required. There is obviously an inverse relationship between the density of hair that can be produced and the size of the recipient area being treated. The art of hair transplantation allows the surgeon to cover a larger area with lower density but still achieve a good cosmetic impact (Fig. 6.2). The limits can only be stretched so far [7]. In most situations the goal is to create coverage that will look like early stages of patterned hair loss when the patient’s alopecia has reached its end point. The goal for women is to improve certain styling options [8]. A minority of patients have very limited patterns of alopecia and are destined to develop into Norwood stage 2 or 3. Hair can be transplanted at higher densities in these individuals because the donor supply is abundant and the alopecic areas are limited.



	Above avg density	Avg density	Below avg density
Type V	7904 (3,000–12,000)	6404 (2,000–10,000)	4963 (1,000–9,000)
Type VI	6661 (2,000–10,000)	5393 (1,250–9,000)	4204 (500–8,000)

Numbers represent mean of each category with range in parentheses

Fig. 6.1 A group of 39 expert hair restoration surgeons (with a combined 900 years of expertise) were asked to give their estimate of the number of likely permanent donor hairs that were available over the lifetime of patients in various scenarios. This figure shows the results of their answers and highlights the importance of using available donor hair very judiciously. (Reprinted with permission from Unger et al. [6])

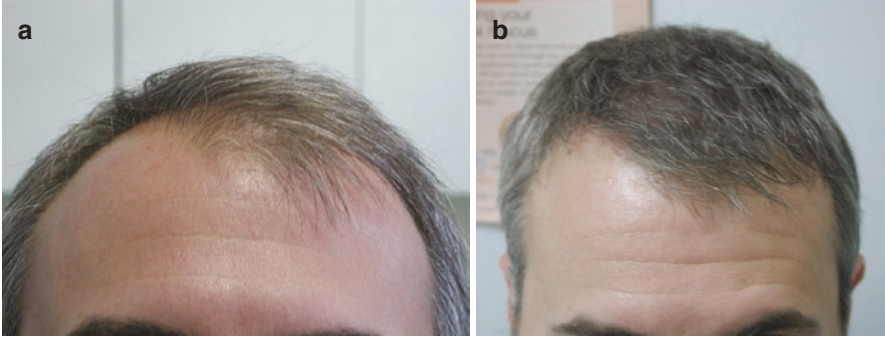


Fig. 6.2 (a) A male patient with fairly advanced hair loss prior to surgery. (b) The same patient 6 months after surgery. This illustrates our ability to cover a larger recipient area with a lower number of follicular units per square cm (FU/cm²) and still achieve good cosmetic density



Fig. 6.3 (a) A young patient before surgery with a significant amount of pre-existing hair that will be lost in the future. (b) The same patient showing the pattern of the sites in the recipient area. (c) One year after the surgery. There is a lower density “feathered” hairline and density increases posteriorly. Over 50% of grafts were used in areas with existing hair. The density was further increased in those areas by using double follicular units (DFU) in the center midscalp

In order to create the illusion of density, a good HT surgeon will create a feathered, lower density hairline and increase the density posterior to the hairline zone (Fig. 6.3a–c). A central forelock of higher density hair will make the patients’ hair

look fuller than it really is. In some patients density is also somewhat weighted in the area of the part-line [9].

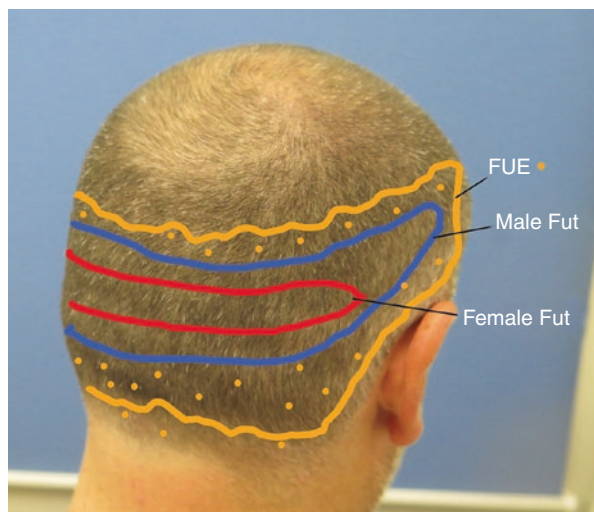
Surgical Planning of the Donor Area

A careful assessment of the donor area is critical in order to determine reasonable goals for the surgery. Patients with female pattern hair loss (FPHL) and male pattern baldness (MPB) have regions of the scalp that are much less affected by alopecia over their lifetime. This region is referred to as the safe donor area (SDA). The hair in the fringe will thin somewhat over time, but the hair in the center of the most dense area of the fringe is the most permanent and therefore the most ideal for use in hair transplantation (Fig. 6.4).

The donor evaluations are somewhat different depending on the harvest method to be utilized.

An elliptical/strip harvest requires an assessment of the overall width of the SDA, the density within different regions along the ellipse, and evaluation of scalp laxity (which determines the width of the strip that can be removed without creating excessive tension upon closure) [10]. The strip may be one very long ellipse, a shorter and wider ellipse (laxity allowing), or two or three shorter ellipses to harvest different caliber hairs and break up the scar remaining after surgery. Each harvest should remove the previous linear scar left behind from the last surgery to minimize the impact on the donor area. This is one of the great advantages of the strip harvest. Regardless of the number of surgeries or grafts produced, only a single linear scar is left behind in any region. The other significant advantage is that hair is taken from the most permanent region in the SDA. It should be the primary harvest method for larger female hair transplant surgery.

Fig. 6.4 This illustration shows the approximate areas of harvest available for donor hair removal using FUE and strip harvest techniques in men and women. The inferior and superior borders of the FUE harvest region are called the feathering zone. It is harvested more lightly, and large FU groups (with 2–3 hairs) are targeted to increase the chance of long-term survival



FUE surgery requires, and allows, for some expansion of the harvest area beyond the traditional SDA. The sites of the harvest cannot be too close together or complications can occur, including excessive scarring due to overharvest and in worse cases necrosis secondary to severe vascular damage [11]. Depending on the size of the punch being used for the harvest, extraction sites need to be spaced at reasonable distances from one another. There is some debate in the field regarding the spacing of extraction sites. The smaller the external diameter of the punch, the closer the sites can be. The extraction sites of larger punches likewise need to be spaced further apart. This spacing in FUE means that a wider area needs to be harvested in order to produce a good number of grafts and also keep the hair density in the fringe looking natural. The further one moves from the densest area in the SDA, the less permanent the hairs are likely to be over the patient's lifetime. Larger groups of higher caliber hairs can be chosen from the periphery of the fringe to feather the extraction area and improve the chance of longer-term results, and some young patients are happy for even the temporary effect of those grafts.

A good HT surgeon should be able to perform both kinds of harvests and know when it is appropriate to use and what are the advantages and disadvantages of each method (Fig. 6.5). This issue is very controversial in the field, and the opinion presented here is that of the author's.

An elliptical harvest produces more permanent grafts in one surgery and over the patient's lifetime. It allows for maximal harvest of the SDA and leaves behind a minimal scar and minimal impact on the density of hair in the fringe. The grafts produced have protective surrounding tissue and are therefore less susceptible to trauma during transplantation. The FUE harvest leaves small punctuate scars but no linear scar, and this is advantageous for some patients. It requires no sutures and

Fig. 6.5 A patient who underwent both FUT and FUE harvest showing the "thinned-out" density on the FUE harvest area as well as the linear scar that can easily be hidden by hair worn longer. (Photo courtesy of Dr. Jerry Cooley)



thus is more comfortable postoperatively. It does thin the hair in the donor rim, and therefore, one is limited in how many grafts can be excised using this method – each graft produced leaves a small scar behind that is not excised with subsequent procedures and therefore is cumulative with each surgery. It is the best choice for patients with very poor scalp laxity, those who wish to wear their hair very short, and those who have had previous strip surgeries and want some additional hair in the recipient area or FUE grafts in the linear scar. It can also be a good way to “test the waters” in the sense that a young patient can do one FUE procedure without “committing” to the linear scar.

Preoperative Instructions

Prior to surgery, a scalp biopsy may be performed if there is any uncertainty as to the etiology of alopecia [12]. The preoperative instructions include discontinuation of anticoagulants (with the guidance of a primary care physician if necessary), no alcohol or marijuana, cessation of vitamins containing fish oil and vitamin E, and some basic blood tests. For those having an elliptical harvest procedure, head massages can increase the scalp laxity to allow for maximal harvest. Most surgeons performing large FUE surgeries also require shaving of the donor area, although smaller sessions can be performed without shaving the donor.

Anesthesia

Many HT surgeries are performed with only oral sedation (usually diazepam) and local anesthesia. The author uses more sedation to help the day pass faster and more comfortably for the patient, including lorazepam and some additional IV midazolam and fentanyl. Although 2% lidocaine with 1/100,000 epinephrine is most commonly used for the ring block, there are patients who require 3% or 4% lidocaine with 1/50,000 epinephrine. Patients with red hair, freckles, or green in their eyes often fall into a category of those for whom 2% lidocaine is often insufficient [13]. A nerve block is also useful for other patients.

Technique of Donor Harvest: Elliptical Excision (STRIP)

The donor strip is removed in one piece or three smaller sections. The author sometimes uses the latter technique to minimize the potential look of a long wave of hair direction change. The hair on the superior edge of the strip tends to be coarser and lie at a less acute angle as compared to the finer hair on the inferior edge. When the strip is removed and the two edges are closed with sutures, this change in caliber and direction

may be noticeable in patients who wear their hair at shorter lengths. Once the ellipse has been removed, larger vessels are cauterized if necessary and the defect is closed.

Sometimes a trichophytic technique is used to improve cosmesis of the resultant scar. Prior to closing the defect, a 1-mm superficial section of epidermis is removed to create a ledge. The superior edge of the wound is brought over this ledge, so that epidermis is properly approximated. When the wound heals, the hair from the inferior ledge grows through the scar and helps minimize the appearance of a linear scar [14]. This closure technique is not used in every case because it does require extra laxity and may cause ingrown hairs during the healing phase. Closure is achieved with either single- or double-layer closure. If deep sutures are indicated, the author uses 4–6 single sutures of 3.0 PDS. The superficial suturing is a running stitch with 4.0 Prolene, although other surgeons favor staples.

Technique of Donor Harvest: Follicular Unit Excision (FUE)

Usually, the author performs large FUE cases over 2 days. The afternoon prior to surgery, recipient sites are created, and the following day, grafts are harvested and placed in the sites. This minimizes out of body time, while still allowing for larger cases up to 1500–2000 grafts. The FUE technique of donor harvest may be performed using a growing variety of devices. All utilize a small punch to excise the follicular unit, which is then removed one by one. There are a robotic device, a suction device, blunt punches, sharp punches, hybrid punches, a manual punch, and a rotating or oscillating removal device. The author has tried many of these devices and currently prefers to use a hybrid “trumpet-shaped” punch with an oscillating motor [15]. The punch has an exceptionally small external diameter, of 0.85–0.95 mm, but the unique trumpet design produces a follicular unit with more surrounding protective tissue. In large cases, usually the donor area is shaved prior to harvesting to allow for a faster and more efficient harvest. If the patient is really opposed to shaving, a smaller area can be harvested, leaving hair above and below to cover the shaved area after surgery. Alternatively, smaller sessions can be performed with long hair, by clipping individual FU, one by one, prior to excising the unit.

Body hair FUE, removing hair from regions other than the scalp (including beard, leg, chest, and back), provides an additional although less dependable source of grafts [16]. The beard hair has the highest rate of success, while according to various studies, other parts of the body produce a viable hair 0–70% of the time.

Technique of Creating Recipient Sites and Placing Grafts

One of the most important aspects of creating the recipient sites is to follow the angle and direction of the existing hair [17]. This creates a result which has the irregularities seen in nature – and protects any pre-existing hair from damage during

the surgery (see Fig. 6.3b). The hairline is designed to frame the face and has both macro- and micro-irregularities in order to mimic natural hairlines [18].

Recipient sites are produced by using a needle or blade cut to size. Single-haired FU is placed in 20G sites, while units with 4–5 hairs require larger 19G to 18G sites. The front hairline is created using 20G sites. Depending on the hair density desired, the sites are usually created at 30–40 sites per cm². Behind this front hairline, two-haired FU is placed in sites at densities of 25–30 per cm². The larger three- to five-haired grafts can be created at lower densities, while still achieving good resultant cosmesis. Sometimes as little as 20 per cm² can produce good densities and allow for larger areas to be covered in one surgery. The central tuft of hair behind the hairline should have the highest density in order to create the illusion of volume when viewed from the front. There are HT surgeons who consistently cut all FU into smaller one- to two-haired units and either distribute them evenly or create areas of higher density by creating the recipient sites at higher density. This sub-sectioning of intact FU does create a greater risk of damage to the follicle and therefore is rarely performed by the author.

The surgical plan decided upon prior to surgery guides the surgeon in creating the sites [19]. The author virtually always treats future areas of alopecia simultaneously with current areas of hair loss. The future areas of MPB are treated at lower densities to help join the areas of higher density with the fringe of permanent hair in the long term.

Grafts are stored in special storage solutions. HT surgeons differ in their approach to this issue. The newest information has guided the author to somewhat change in this regard [20]. Until recently all grafts were stored in a chilled solution of hypothermosol and liposomal ATP, and this is still the approach for cases where grafts may remain outside the body for longer than 6 hours. However, the chilling of grafts does result in some damage, and therefore the author now keeps grafts in the patient's own platelet poor plasma (PPP) or saline with ATP at room temperature – if the out of body time is predicted to be less than 6 hours.

Prior to the insertion of the grafts, the author injects platelet-erythrocyte-rich plasma with ACell (PeRP + ACell) [21]. Only a minority of surgeons perform this step, but the author has found that the PeRP (which is a variant of the regular PRP) helps promote earlier and more vigorous growth than was seen prior to the use of this technique [22]. Grafts are first placed in ring holders containing the PeRP + ACell as well and then inserted into the recipient sites using jeweler's forceps or dull implanters. Implanters have improved significantly in the last few years and many surgeons are moving to exclusive use of implanters because of the decrease in trauma and recently evident improved results.

Postoperative Course and Complications

After surgery, a bandage is applied in a turban-like fashion. This helps keep grafts in place overnight, prevents the patients from accidentally scratching at their head in their sleep, and occludes the surgical site to promote improved wound healing. The bandage is removed the following morning, the grafts are checked and adjusted

if necessary, and the hair is washed [23]. Patients who have had elliptical harvests have sutures removed 8–12 days after surgery.

Common postoperative sequelae include change in sensitivity of the scalp, postoperative edema of the forehead and temple regions, and potential for telogen effluvium (15% of male patients, but closer to 50% of female patients). The telogen effluvium is temporary but can be distressing to the patient. Other more common potential complications include folliculitis, infection, and nerve irritation (very infrequent).

Special Circumstances

Hair transplant surgery may be used to treat patients with postradiation alopecia, scars after burns, trauma or surgery, as well as those who developed alopecia after an infectious or fungal disease [24]. The surgery can be performed on regions of the body other than the scalp – including the beard, eyebrows, eyelashes, and chest [25]. Each of these special circumstances requires a slightly different approach, and the technical aspects are adjusted accordingly.

Expected Results

The grafts often shed the hair in the first weeks after surgery; however the change in holding solutions and use of PeRP + ACell has resulted in more patients who retain this hair. The new hairs start emerging 3–4 months after surgery. The patient has a good idea of what is to come by 6–7 months postop, while the full effect can require 12–18 months to be fully appreciated (Fig. 6.6a, b). The process is very subtle and

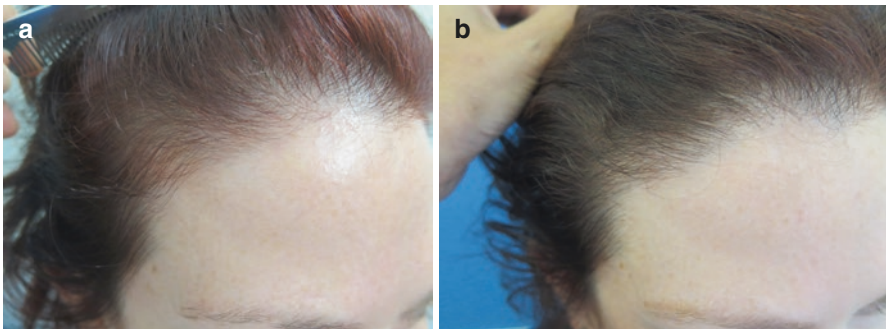


Fig. 6.6 (a) A female patient before surgery. (b) The same patient 1 year after surgery showing improved density and a better advanced hairline with a feathered look and increasing density posteriorly. Again, over 50% of grafts were placed to thicken areas of existing hair that will thin further in the future

natural because the hair grows in gradually and follows the angle and direction of existing hair.

As with all techniques, hair transplant surgery results vary depending on the skill and experience of the surgeon and their team. There are HTs performed today that push the boundaries in various ways and result in poor cosmetic appearance for the patient [26]. The donor can become overdepleted, scars from harvest can become visible, and the hair transplanted can be poorly distributed or placed. However, a skilled and ethical surgeon with a dedicated team produces results which are undetectable, natural, and longlasting.

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