HAIR RESTORATION SURGERY

Manoj Khanna
Cosmetic Surgery Clinic
12, Loudon Street, Flat 3C, Kolkatta - 700017, India.

Abstract : *With the evolution of finer techniques in hair transplantation the results look more and more natural. Hair restoration is one of the most exciting and innovative surgical fields in cosmetic surgery today. A precise appreciation of the anatomy has allowed the use of follicular unit grafts. With better methods of harvesting and implantation, hair transplantation results reveal a blend of art and science.*

INTRODUCTION

Hair transplantation is one of the most rapidly evolving procedures in cosmetic surgery, with improvement in techniques occurring regularly. The recent advances in technology and the concept of using *follicular unit grafts* have made this procedure reach a new plateau. The ability to provide very natural appearing results has augured larger number of balding men and women to opt for this surgical solution.

PATHOPHYSIOLOGY

The clinical onset of baldness in both men and women is generally around the age of 30 to 40 years. A strong family history is one of the best indicators of *male pattern baldness* or *androgenic alopecia*, which is the commonest cause of hair loss. An autosomal dominant genetic linkage is believed to cause this hair loss. Male pattern baldness may begin in the teenage years, and becomes more common as men age. It is known that the male hormone, testosterone, gets converted to another male hormone, 5 dihydroxytestosterone (5-DHT), in the hair follicles. In genetically susceptible men, under the influence of 5-DHT, the hair follicles on the front and top of their scalps begin to become more fine over the years. The hair growth also gets restricted and eventually the hair disappears completely.

Like most tissues, hair undergoes a continuous turnover throughout life. Hair follicles are replaced periodically, and at any given time they are in one of the three stages of the growth cycle. The actively growing stage (*anagen phase*) is followed by a brief period of morphological change or the involution stage (*catagen phase*). This is then followed by a resting stage (*telogen phase*). In normal human beings, the total number of scalp hair is usually one lakh. Hair grows at the rate of 1 to 2 cm every month and the average duration of anagen phase is 3 years whilst that of telogen phase is 100 days. Approximately, 40 to 100 hairs are shed daily, but this rate increases in late summer and early autumn, and decreases in late winter or early spring, due to effects of temperature. Norwood has classified baldness into seven stages (fig.1). In women, the frontal hairline is usually spared and baldness in them has been classified separately by Ludwig (fig.2).

Hair transplantation is based on the *'theory of donor dominance in androgenic alopecia'*. If a graft is taken from an area destined to be permanently hair bearing and transplanted to an area of future or currently suffering male pattern baldness, it will after an initial period of effluvium, grow hair in its new site as long as it would have at its original site. This is the scientific basis of hair transplantation surgery.

TERMINOLOGY

Terminal hair is androgen-dependent male-type hair on face (mustache, beard and sideburns) and body (chest, areola, linea alba, inner thighs). It increases in hirsutism. Vellus hair is non-pigmented fine "peach fuzz" hair covering the body, in both children and adults. It increases in hypertrichosis.

The *follicular unit graft* (FUG) as described by Headington [2] includes 1 to 4 terminal hair follicles, 1 (or rarely 2) vellus follicle, associated sebaceous lobules, insertion of erector pili muscle, perifollicular

Fig.1 Norwood's classification of male pattern baldness. Grade 1 is near normal. (V) means Vortex.

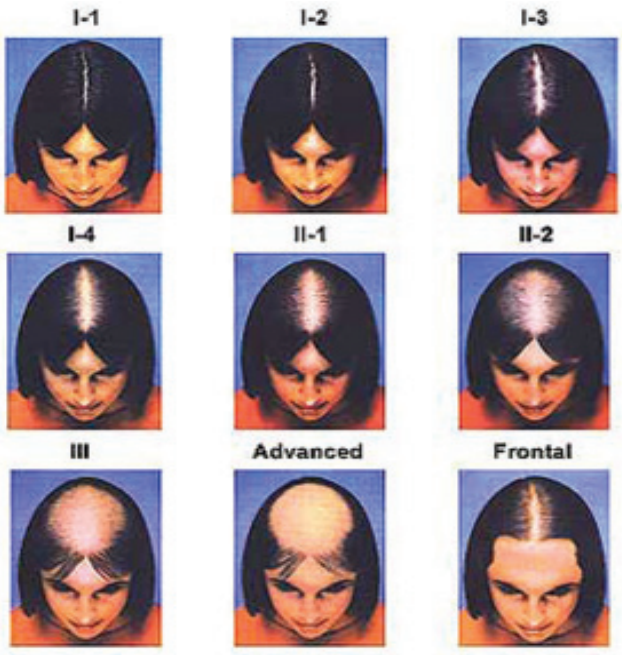

Fig.2 Ludwig's classification for baldness in females.

Correspondence : Dr. Manoj Khanna
E-mail : drmkhanna@hotmail.com

neurovascular network etc. This definition suggests that the unit is a physiological entity rather than an anatomical one. It is best to describe a *follicular unit* for all practical purposes as an aggregation of hair shafts emerging from the scalp in which the distance between the hairs is less than the distance to the nearest aggregation of hairs. This pattern has to be kept in mind whilst harvesting, dissecting and transplanting hair to achieve maximal efficiency and to give a natural appearance to the patient.

TECHNIQUE OF HAIR TRANSPLANTATION

Planning

Although, age is no bar for hair transplantation, the pros and cons of a transplant need to be carefully evaluated in the younger age group. Patients between 20 to 30 years of age should have a stabilized rate of hair loss before they are considered for hair transplantation. A detailed family history is useful in assessing hair loss and planning a new hairline. The colour, quality and density of the donor hair, and the contrast between the hair colour and the skin colour, are important factors that affect the result. The lesser the contrast between the donor hair and the skin, the better is the result [1]. It is also noted that frizzy, curly or wavy hair are advantageous characteristics in transplanted hair.

Single hair grafts are used to create a natural hairline. The planning of the hairline is one of the most important steps in hair transplantation. The hairline is the most visible landmark and the quality of work of a surgeon is often judged by the quality of the hairline. To locate the ideal hairline in a bald patient it is necessary to divide the face in to three equal segments as suggested by Michaelangelo [3]. In the midline, the hairline starts at least eight centimetre or more from the glabella (fig.3). A curve sweeps around to the lateral side of the forehead from the center. At this point, the sides of the hairline should be oriented parallel to the curve when the subject is looking straight ahead. The lateral hairlines are usually 9.5 to 11.5 cm above the lateral canthus of the eyes. The temporal angles should form relatively sharp right angles or acute angles in most men but in women these angles should be more rounded. The hairline shape also varies according to the variation of the shape of the face – round, oval or triangular. The patient's desires and constraints are also other factors that can affect the shape of the hairline.

Usually 250 to 300 single hair (micro) grafts will be necessary to create a new hairline in any individual. The micro-grafts in the hairline should be placed in an irregular saw-toothed pattern of macro- and micro-irregularity [4] to give a natural appearance. Behind the hairline, two-hair FUGs are used to provide new hair. Three or four hair FUGs are used just further behind. The less ideal the hair and skin characteristics, the more important it is to use smaller grafts. In alopecic recipient areas, punch grafts of diameter 1 mm, 1.25 mm and 1.5 mm are used by some surgeons behind the hairline to give good density. The punch grafts have an advantage of removing a circular area of bald tissue where the grafts will be placed. These punch grafts should not be used in areas where hairs are already present as they would punch out existing hair and the surgery will be counter productive. But in areas of total baldness punch grafts can be useful.

Pre-operative Preparation

The patient is asked to shampoo his head with povidone iodine surgical scrub on the day before the surgery and on the morning of the surgery.

Preparation of the Donor Area

Local anesthesia is used for the entire procedure. A solution is made from 30 ml of 2% xylocaine with 100 cc of normal saline, to which 1 ml of adrenaline (1:1000) is added. The hair in the donor area (occipital region) is trimmed to about 2mm length and the local anaesthetic solution is injected just under the donor area. The donor area is then tumesced by injecting normal saline into the entire zone. Allow 10 minutes for complete haemostatic effect to minimize bleeding. The donor area should be turgid at the completion of infiltration because this provides excellent anesthesia and results in minimum bleeding.

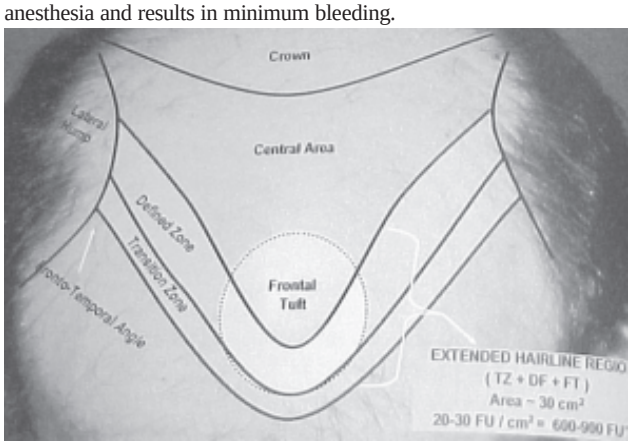

Fig.3 Illustration to show how the hairline is planned in a bald patient.

Harvesting

The donor strip can be harvested with a single bladed knife or a multiple bladed knife containing three to seven blades. The multi-bladed knife harvests numerous (two to six) parallel strips of varying width, depending on the spacer used, which may be 1.5mm, 2mm or 2.5mm. These blind incisions, with a multi-bladed knife, increase the chance of follicular damage, and therefore, it is better to use a single or a double-bladed knife (fig.4). It is very important that whilst harvesting the donor area the blades remain parallel to the direction of the hair so that the hair roots are not damaged. The hair in the lower part of the occipital area and the temporal area are finer, and these should be used to create a new hairline. After the strip has been harvested, the gap can be closed either by staples or by sutures. Some surgeons prefer deep sutures in the galea or the subcutaneous tissue to reduce the width of the scar, but this is not always necessary. The skin can be opposed by a running suture of 2 '0' monofiliment nylon. Care is taken to take the bites close to the skin margin to avoid more damage to the tissues. Also, it is important to take the bites only up to the dermis so that the deeper hair roots are not damaged, and can be utilised in subsequent surgery.

Follicular Unit Extraction [6] is a technique that involves the removal of the intact follicular unit directly from the donor area using a 1 mm punch. The yield by this technique of harvesting can diminish due to transection and avulsion injury to the follicular unit.

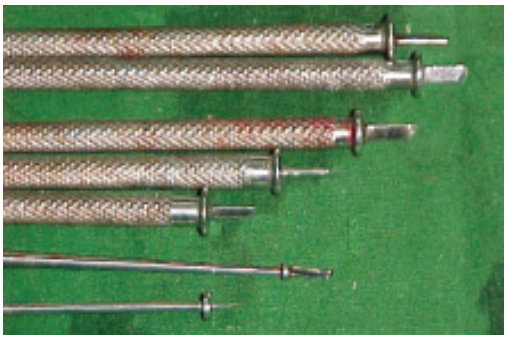

Fig.4 Instruments used in hair restoration surgery for follicular unit harvesting, making of recipient slits and implantation.

Harvesting donor hairs which are white or light coloured is more difficult. Extra care has to be taken to preserve the hair follicles. These patients are instructed to dye the hairs a few days before the procedure to enhance visibility. Extra care is also required in patients undergoing a second procedure because scars from previous surgery distort the direction of the hair in the donor area.

Graft Preparation

The harvested donor strips are immediately immersed in chilled normal saline. Proper hydration of the donor grafts with cold saline is very important throughout the surgery as it influences the survival rate of the grafts. In case a single large strip has been harvested it can be divided into smaller pieces or slivers [5] before the cutting of individual grafts. The subcutaneous fatty tissue below the hair roots or bulbs is stripped leaving up to 2mm of fat below the hair bulb. FUGs are made having one to four hairs. Grafts are immersed in saline, in a petri dish, or kept on a moist stockinet in kidney trays, in bunches of 25. Good illumination is essential during the cutting of the grafts. The grafts may be cut on wooden tongue depressors or on a clear vinyl dissecting surface, with a backlighting system. It is important that no piece of wood sticks to the grafts after they have been cut, because these foreign bodies can later form troublesome epidermal cysts. Loupe magnifications with power 2x or 3x is useful in creating FUGs. Graft preparation with a dissecting stereo microscope makes the dissection a little slower, but it is much more accurate. Some surgeons prefer slicing the epidermis in the grafts at an angle of 45 degrees, but this is a personal preference.

Preparation of the Recipient Area

Anesthesia for the recipient area includes a supra-trochlear and supra-orbital block followed by a ring block in the frontal area beyond the zone of hair transplantation. The recipient area itself should be tumesced well with normal saline. It is author's preference to avoid using adrenaline in the recipient area because this has shown to diminish the uptake of the grafts and it also increases telogen effluvium in the immediate post operative period. Adrenaline must definitely be avoided in the recipient area in women [7] because severe effluvium has been reported after its use. The recipient area should be turgid before slits or holes are made, to minimize bleeding and pain.

While making slits or holes in the recipient area it is very important to follow the direction of the existing hair in that region. The hairline should have a ragged, saw-toothed natural look. Holes are made with a No. 18 / 20 gauge needle in a pattern of organized disorganization. About 250 to 300 micro-grafts are necessary to create a normal hairline. Behind the hairline, slits can be made by Nokor needles, a Minde knife (A – Zee Surgical, USA), a No. 5 scalpel blade or by needles. The author has devised a new instrument which is patented as "Kolkata slit". The Nokor needles and Minde knife are disposable instruments and not easily procurable in our country. The scalpel blades make holes that are too large and often deep, because of which the inserted grafts float and loose direction. Scalpel blade can also cause significant damage to the existing hair in the recipient area. In females, a large number of hair strands get cut by the scalpel blade during the procedure. The 'Kolkata slit' is an instrument which can be re-used and comes in different sizes. It creates a gap just about the size of the graft to be inserted and ensures the graft maintains the direction of orientation. The slit must be used in areas where there are existing hairs in an attempt to increase density.

In patients undergoing secondary or tertiary procedures an increased amount of bleeding has been noticed in the recipient area. Increased bleeding is also seen in patients who have been using minoxidil in the pre-operative period. Good tumescence, and a waiting period of 10 to 15 minutes, before making gaps can reduce this disturbing ooze. It is also noticed that the gaps in recipient areas are tougher to make in secondary procedures because of fibrosis from earlier procedure.

Graft Insertion

The grafts are placed into the recipient slits / holes using fine angled forceps (fig 5). It is important to employ an atraumatic technique for graft placement. The FUGs are grasped on the 2mm of subcutaneous tissue left below the hair bulbs to position them into the recipient sites. The grafts should not be grasped by the follicle end to avoid damage. A steady pressure is applied to ensure that the grafts are flush with the surrounding skin. Burying the grafts beneath the level of the skin must be avoided because it can give a pitted appearance and also lead to formation of epidermal cysts. If the grafts are too elevated from the surface it creates a cobblestone appearance. Two, or even three, persons can insert grafts at the same time to make the procedure faster and efficient. Grafting sessions can last up to five or six hours, in which 2000 - 3000 FUGs may be transplanted.

Post-operative Care

The patient is discharged the same day, usually without any bandage.

Fig.5 Follicular unit grafts just before insertion in to the recipient slits.

Some surgeons still prefer to bandage but it must be done very carefully to avoid shearing. The bandage must also be removed very meticulously because grafts can stick to the undersurface and get removed inadvertently.

Some swelling is obvious after a hair transplantation surgery and the patient should be informed of this prior to the procedure. A head-band worn immediately post-operatively is useful in preventing the swelling from coming down on to the face and creating a puffy appearance. The patient is instructed to wash his hair with a mild shampoo on the 2nd or 3rd postoperative day. Whilst combing his hair in the transplanted area, the tooth of the comb should not strike against the transplanted plugs for three weeks. Wearing clothes like T-shirts or pullovers which have to be taken off over the head should also be avoided for three weeks. Hair oils or other stronger shampoos and helmets are also avoided for the same period. 5% minoxidil is applied in the areas of hair transplant once the shampooing has begun, and continued for a period of two to six months. This has shown to promote earlier growth of the transplanted hair. In females the concentration of minoxidil used is 2%.

Sequel

The epidermis and dermis along with the shaft of the transplanted hair outside the skin fall off as scabs in the two to three weeks after the surgery, but the follicles remain and go into a resting phase. New hairs start growing about 3 months after the procedure. It has often been noticed that with the use of 5% Minoxidil the hairs don't fall and start growing immediately in the post-operative period. It usually takes six to nine months to appreciate the result of a hair transplant. If a second procedure has been planned, it must be at least three to six months after the first sitting. Some patients may complain of

hypoaesthesia of the scalp in the donor area. It is usually temporary, but may persist for as long as 18 months in some cases.

The density of transplanted hair is usually thinner especially in areas that are totally bald. The patient should be informed of this pre-operatively and a second sitting can be undertaken to increase hair density (fig. 6 a&b).

Complications

Complications of hair transplantation are few and rare. True infections in the recipient areas occur infrequently. In the donor areas, infection may be seen around the sutures but it usually resolves easily after suture removal. Epidermal cysts may be seen occasionally and need drainage. It is important not to harvest too big a donor area because tension on the suture line can lead to dehiscence and a wide scar.

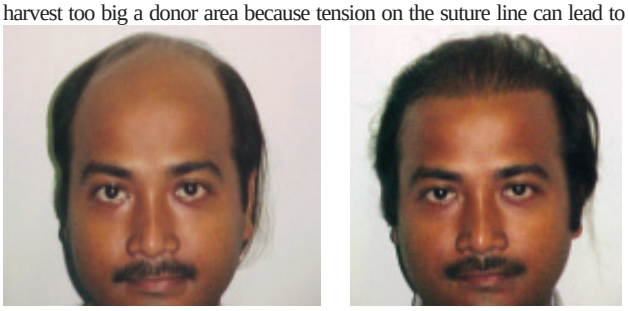

Fig.6a & 6b: A 25 year old male with grade 7 baldness. Before (a) and after (b) Showing the hair restoration after a single sitting of follicular unit transfer with 1500 grafts.

HAIR TRANSPLANTS IN SPECIAL SITES

Eyebrow transplantation can be done to improve or recreate eyebrows. It is an aesthetic essentiality to follow the direction of the eyebrow hairs whilst creating a new line. Around 150 micro-grafts are usually required for an eyebrow of one side. The donor site for eyebrow transplantation should be of finer hair preferably from the nape of the neck or the temporal region [8]. Recipient holes are made with a No. 20 or 21-gauge needle or a 0.7 mm micro blade. Cyanoacrylate glue may be used over the grafted areas to keep the them in place during the immediate post-operative period.

Grafting eyelashes is a more challenging procedure. Fortunately, only a few lashes are necessary to produce a good result. Six, one-hair micro-grafts per lid may satisfy most patients. The cyanoacrylate glue is again very useful in keeping the grafts in place.

The rate of hair growth of the scalp hair is much faster than those of the eyebrows and elsewhere. Patients must be informed pre-operatively that this transplanted hair will need trimming from time to time.

Moustache reconstruction by hair transplantation is especially useful in patients who have had a cleft lip or a scar following trauma. The hair in the moustache area is much more wiry and courser than hair in the scalp. Probably harvesting hair from the beard area just inferior to the jaw line provides better donor hair for moustache reconstruction [9].

Patients who have undergone hair transplantation using older techniques have larger plugs. This gives the hairline a pluggy, cornrow appearance, which needs correction. The current approach is by plug reduction and recycling, and it is applied aggressively to the front two rows [10].

CONCLUSION

Recent advances in technology have made hair replacement surgery a viable option for many people but we must utilize this technique prudently. It is very important to form a team because one individual cannot perform the entire procedure single-handedly. Fine tuning and accuracy in all steps of the surgery are essential in getting good results. No compromise should be made with proper lighting in the operating room and with the quality of instruments. A comfortable ambience in the operating room and use of audio-visual entertainment break the monotony, both for the patient and the surgical team. A patient is worse off after a poorly performed hair replacement surgery. If done judiciously, transplantation is a very rewarding procedure, both for the surgeon and the patient (fig.7 & 8).

Fig.7a & 7b A 26 year old male with grade 7 baldness. Before (a) and after (b) Showing appearance of the patient after a single sitting of follicular unit transfer with 1300 grafts.

Fig.8a & 8b A 26 year old female with cicatricial alopecia from childhood. Before (a) and (b) Showing the same patient after two sittings of 1000 grafts each.

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Nobel Prize in Medicine

Drs. Andrew Fire and Graig Mello have been awarded Nobel Prize in Medicine for the year 2006 for the discovery of "***Silence Genes***" which has opened new pathways for treating diseases by the nobel assembly of stock Holmel Karlinsaa Institute. Through their experiment with Nematode worms; both scientists form of RNA can switch off targeted genes in a process known as RNA interference. This technology has become a hot area of research for pharmaceutical companies who view this as a promising new way to tackle a range of conditions.