

Review Article

Hair transplantation in androgenetic alopecia

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Received : 20-May-2021

Accepted : 25-May-2021

Published: 24-June-2021

DOI

10.25259/CSDM_14_2021

Quick Response Code:



ABSTRACT

Androgenetic alopecia is the most common cause of non-scarring alopecia in men. Even though the past couple of years have seen significant advancements in the management of patterned hair loss. Medical therapy as a standalone treatment remains unsatisfactory and surgical restoration of hair has found to be extremely gratifying as far as male pattern hair loss is concerned. In this article, we will review the latest developments in the field of hair transplantation undertaken in androgenetic alopecia.

Keywords: Hair transplant, Follicular unit, Androgenetic alopecia, Graftsurvival

INTRODUCTION

Hair restoration is highly pursued in the current scenario due to our obsession with appearances. Due to this huge requirement, hair transplant is one of the most demanded procedure, with notable developments in the field of trichology. The past couple of years have seen significant development in the management of androgenetic alopecia (AGA), since it is the most common cause for baldness in men. Advances in the field of hair transplant have occurred drastically in the last couple of years from punch grafting to robotic hair transplantation. The field of hair transplant surgery is undergoing prominent advancements with the goal of optimizing the results and ensuring better graft survival.

History

Hair loss issues date back to 1500 BC, in which “The Ebers papyrus” of ancient Egypt has recorded solutions for hair restoration.^[1] Punch grafting for hair restoration was first introduced by Dr. Norman Orentreich, a dermatologist from New York in the early 1950s.^[2] Dr. Norman Orentreich developed a method, which comprised of a 4.0-mm punch, and where this “punch grafting” was later performed by many small practitioners all over the world until 1975. However, this technique was associated with its own issues, therefore in order to overcome the “doll look” appearance, associated with “punch grafting,” smaller grafts called “mini” and “micrografts” were introduced in the 1980s [Figure 1].^[1] In 1984, Headington^[3] demonstrated the concept of hair “follicular unit” via transverse sections of scalp biopsies, which proved that hair did not occur singly, but as groups which were called a “follicular unit.” Each “follicular unit” consists of 1–4 terminal follicles, sebaceous gland, arrector pili, perifollicular vascular plexus, nervous supply, and perifollicular collagen. This concept paved the way for both, follicular unit transplantation (FUT)

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Figure 1: “Doll’s look” appearance seen with punch grafting.

and follicular unit extraction (FUE) techniques^[4] of hair transplantation. Automated FUE technique in turn overcame the limitations of old school FUE and it is now possible to achieve more than a thousand grafts in one day in trained hands. In 2006, an innovative method called the surgically advanced follicular extraction (SAFE) system was introduced by Dr. Harris,^[5] with extremely low transaction rates of an average 6.14%.

Methods of hair transplantation

1. FUT (Follicular unit transplantation or strip technique)

This method involves single strip donor harvesting taken from the donor area via an elliptical excision, followed by suturing. Although with the newly described trichophytic closure, it is possible to reduce the visibility of the scar;^[6,7] however, it still poses a cosmetic problem for patients who wish to wear short hair [Figure 2].^[8,9] FUT has many other disadvantages such as being labor intensive and time consuming. Due to these reasons, FUT is preferred in certain specific conditions and FUE has become more popular in today’s era.



Figure 2: Linear scar visible in the donor area with follicular unit transplantation (FUT).

2. FUE (Follicular unit extraction)

Originally, known as the “FOX procedure,” FUE, FUSE (Follicular Unit Separation Extraction) method, Wood’s technique, or FU Isolation method is rapidly becoming a substitute to the strip technique. Bernstein and Rassman started developing the FOX procedure, proclaiming it as a new surgical method for hair restoration without strip harvesting [Table 1].^[10-13]

Donor dominance versus recipient influence

Donor dominance as described by Orentreich, is the ability of the transplanted hair grafts to maintain the characteristics of donor site after transplantation to recipient site. This helps in hair transplant as hair from permanent donor zone of scalp

Table 1: Difference between FUT and FUE.

	FUT	FUE
Harvesting technique	Single strip	Individual follicular units
Microscopic dissection	Required	Not required
Stitches	Required	Not required
Postoperative bleeding/pain	May occur	Uncommon
Nerve damage	Possible	Uncommon
Reaction to suture material	May occur	Uncommon
Duration of procedure	Short	Long
Fatigue	Not tiring due to shorter procedure	Tiring due to longer procedure
Shaving of head prior to surgery	Not required	Required
Hairstyle in donor area	Short hair not possible	Short hair possible
Healing time:		
Donor area	2–3 weeks	1 week
Recipient area	10–14 days	10–14 days
Recovery time	2–3 weeks	1 week

(Continued)

Table 1: (Contd.)

	FUT	FUE
Patient is fit to return to work	5-7 days	The day after
Visible scarring	Present	Absent
Large areas	Possible faster	Tedious
Cost	Cheaper	Expensive
Staff requirement	More	Less
Natural result in recipient area	Yes	Yes

is transplanted into balding patches in the non-permanent areas of the scalp. Body hair follicles as we know have a short anagen phase, therefore when transplanted produce a mismatch with the scalp hair with respect to characteristics like length, thickness and curls. However, it was observed that the recipient area influences the donor hair growth rate and cycle to mimic characteristics of the recipient hair.^[14,15,16]

Theory of safe donor zone in FUE

The theory of “safe donor zone” is particularly important in today’s era of hair transplant surgery where most of our patients present to us with advanced grades of alopecia with a limited donor area. Due to a limited donor area from the scalp and beard, most surgeons find it difficult to determine the “safe donor area” available for graft harvesting. “Safe donor zone” is defined as an area in which progression of permanent hair loss does not occur. Although, universally there is no proper consensus on the definition for safe donor zone there is enough literature that has attempted to simplify techniques to define it [Figure 3].^[17]

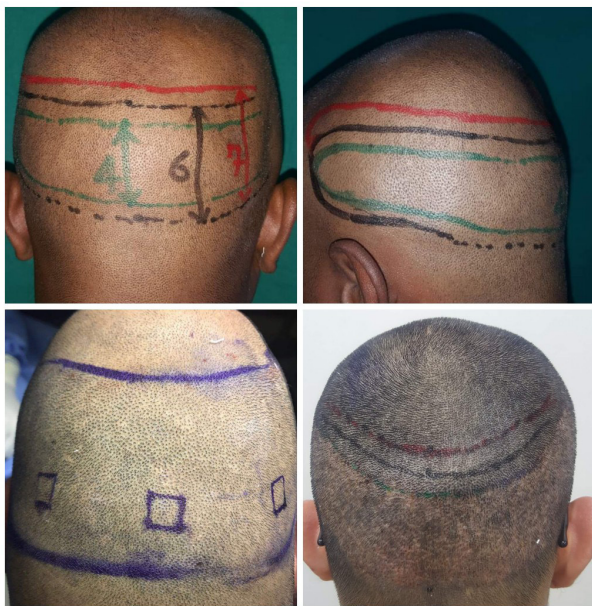


Figure 3: Posterior and lateral view of scalp showing limited, standard and extended safe donor area of the scalp.

FUE technique with non-scalp hair as donor

The major advantage of FUE is that it permits the use of beard and body hair which is essential in advanced cases of baldness with limited scalp donor area.^[18] Even patients who have already undergone a previous surgery and have exhausted their available donor area, can achieve satisfactory results. However, body and beard hair characteristics such as thickness, length, and hair cycle are quite different from scalp hair [Figures 4 and 5][Table 2].^[19]



Figure 4: Single follicular units post extraction from beard donor area.

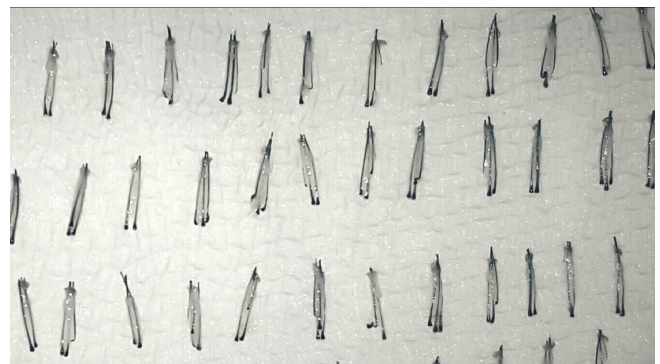


Figure 5: Follicular units post extraction from scalp donor area.

Table 2: Differences between beard and body hair when used as donor hair.

	Beard hair as donor	Body hair as donor
Caliber of hair	Coarse and thick	Fine and short
Useful for implantation in	Vertex and midfront area with scalp hair	Frontal and temporal area with scalp hair
Harvesting technique	Easier	Cumbersome
Extraction process	Faster	Slower
Anagen phase	Longer	Shorter
Tumescence required	Less	More

Body hair characteristics as compared with scalp hair

Hair transplant requires terminal hair and hence, most of the hair on the human body which are vellus cannot be used. Once the androgen sensitive hair in the beard, trunk, axillae, and pubis, become terminal at puberty; can be used for hair transplant. After transplanting body hair, they curl as they grow beyond a certain length.^[19] However, with self-grooming the curly characteristic of body hair can be reduced for a close match with scalp hair.^[20] Body hair lie superficial, in the dermis as compared to scalp hair. Body hair emerge at a more acute angle from the skin surface in comparison to the scalp hair. Usually, body hair grow singly with 1–2 hair follicles within each follicular unit.^[21–24] For beard hair graft extraction, the patient is kept in supine position with neck extended to adequately expose the submandibular area [Figure 6]. After matching the angle and direction of the beard/body hair, smaller punches of 0.75–0.9 mm in diameter are used to score the grafts.

Survival rates of scalp, beard, and chest hair in FUE

FUE is the preferred technique of choice in patients with depleted scalp donor area and advanced androgenetic alopecia. Nevertheless, despite advancements in FUE not much data have been published comparing the results of scalp hair with non-scalp hair in terms of results and survival of grafts. A study conducted to compare scalp hair versus non-scalp hair used as donor in hair transplant surgery, showed a graft survival rate of 95%, 89%, and 76% respectively with beard, scalp, and chest hairs after 1 year of hair transplant [Figure 7].^[25,26]

FUE FROM BEARD



Figure 6: Beard as a donor area in follicular unit extraction (FUE).

Beard, eyebrow and eyelash transplant

Hair transplant is also indicated for aesthetic enhancement in patients who desire denser beard, eyebrow, or eyelashes. It can also be performed for reconstruction of beard, eyebrows, and eyelashes in those suffering from alopecia areata (stable), traumatic scars, trichotillomania, acid burns, etc.

FUE in direct hair transplantation (DHT)

FUE procedure involves three main steps: Graft extraction, followed by creation of recipient area, and then graft implantation.^[27] However, DHT technique, involves a few changes in the above sequence of events. The recipient area slits are created initially, followed by graft extraction and simultaneous implantation. The first step, is called “scoring” which involves, making the skin incision using a punch, inside the skin up to 2.5–3 mm. In the next step, grafts that were scored are extracted using forceps. While the process of scoring is going on, simultaneous graft extraction and implantation follows subsequently. After scoring few grafts



Figure 7: Comparing the results of scalp hair versus non-scalp hair in terms of results and survival of grafts in follicular unit extraction (FUE).

for a couple of minutes, the patient is made to sit erect and the head is lifted off the table. By this time, most of the grafts would have been extracted and some would have been implanted. Then, in the erect position, the remaining grafts are extracted, and implantation of the extracted grafts is completed.^[28] DHT has a novel advantage in the sense, the grafts remain susceptible to injury from the time they leave the body and are completely secure at the recipient site. DHT also helps reduce the chance of mechanical graft dislodging and prevention of crust formation. Second, it ensures continuous meticulous supervision of the staff throughout the procedure to ensure optimal graft handling.^[29] In DHT, while the physician is scoring the donor area with the punch, the assistants are simultaneously extracting and implanting the grafts. Thus, more assistants are working simultaneously and the entire process is streamlined to ensure better graft survival. Also, there is no need of storing the grafts in any storage solution like chilled-ringer lactate, normal saline, or platelet-rich plasma unlike in the standard FUE procedure. In short, the DHT procedure, reduces the “out of body time” of the harvested grafts, thus increases the survival rates and in turn better postoperative results [Figure 8]. The disadvantage faced in the DHT method is that the ease of implantation is less in sitting position.^[28]

Graft management and storage in FUE

Graft survival rate is dependent on the temperature of holding solution, out of body time, minimal handling of the grafts, and the use of biostimulus. Chilled normal saline (1–4°C) is a better holding medium for graft survival as compared to normal saline.^[29,30] Reasons for graft desiccation is due to dehydration, transection, blunt trauma, and ischemia



Figure 8: Postoperative results in a case of FUE with direct hair transplantation.

reperfusion injury. Reducing the duration between graft extraction and implantation is crucial to improve graft survival. Normal saline, ringer lactate, hypothermosol A, ATP activated liposomal solution, and platelet rich plasma are some of the commonly used holding situations.^[31–33]

Graft insertion

The grafts are inserted into the recipient slits using fine-angled forceps. It is important to place the grafts in an atraumatic technique. In FUT, the FUs are grasped by subcutaneous tissue below the hair bulbs to place them into the recipient slits. In FUE, it is advised to follow a “No root touch” technique where the FUs are held by the upper 1/3rd region without damaging the bulb. A steady pressure is applied to ensure that the grafts are at the level of the surrounding skin [Figure 9]. Burying the grafts beneath the level of the skin must be avoided otherwise it can give a pitted appearance leading to epidermal cysts. A cobblestone appearance is seen if the grafts are too elevated from the surface.^[34,8] The techniques for graft insertion are as follows:

- The “stick and place method” involves creating a recipient slit, followed by insertion of hairs into the site by an assistant immediately.
- Creating all the recipient sites at one time and then placing the grafts one by one.
- Using implanters which involves the use of pre-loaded pen-like instruments with an extracted graft in its hollow end, directly into the scalp.
- Creating all the recipient sites and then using an implanter to insert all the grafts together.

Choi *et al.*^[35] devised an alternative approach for speeding up the transplantation process. The follicular units need to be carefully prepared, and are implanted using an implantation device. The “Choi Implanter” is an effective device into which



Figure 9: Implantation of follicular units using fine angled forceps.

follicular unit is loaded. The needle is inserted into the scalp and the plunger is pressed to implant the graft. Commonly it requires a three-person team of two loaders and one planter to implant 12 grafts per minute or around 700 grafts per hour. Alternatively, the slits can be pre-made by the surgeon and the assistants “fill the slits” with the aid of the implanter. This ensures proper density of the grafts and the surgeon remains in full control of the angle, density, and direction of the grafts. Thus, hair transplantation is a comparatively safe and result-oriented surgery, with complications which can be easily avoided by following a few precautionary measures during the surgery [Table 3].^[36]

Learning and practice techniques in hair transplant^[37]

With the advancement in surgical techniques in hair transplant, there is an increasing demand for the procedure that leads to greater requirement for professionally trained hair transplant surgeons. The most crucial step of the surgery is the hairline designing, because this step decides the angle, direction, and density of hairline thus directly impacting the outcome of the surgery. Keeping this in mind a simple yet effective, user friendly and economical technique has been described to help new surgeons practice the step of recipient area designing. This method involves practicing slit creation on a fruit/vegetable model, e.g. using papaya for a cut to size blade and needle holder.

Table 3: Complications during hair transplant surgery and precautionary measures to avoid them.

	Complications during hair transplant surgery	Precautionary steps to avoid them
General complications	Pain: intraoperative and postoperative	Proper use of anesthesia and analgesics Vibrational anesthesia
	Complications due to anesthesia	Testing for hypersensitivity to anesthetic agents prior to surgery
	Infection	Prophylactic antibiotics Proper aseptic precaution intraoperative Proper postoperative washing and wound care of recipient and donor area
Complications after FUT	Donor site wound dehiscence	Multi layered wound closure, avoiding excessive tension along the incision line, adequate postoperative wound care, delaying suture removal, counseling patient to avoid vigorous exercise Intralesional steroid can be injected in the strip
	Scarring: hypertrophic scar and keloid	
	Hematoma	
Complications after FUE	Donor site depletion Postoperative telogen effluvium	Avoid over harvesting donor area by extracting only 25% of existing follicles
	Pin point scarring	Avoid mega sessions in patient with type 4–6 skin
	Buried grafts Folliculitis	Proper alignment of sharp punch with the hair follicle prevents this Maintain proper hygiene postoperative and advocate proper cleansing for the donor area
Recipient area complications	Cobblestoning	Placement of the grafts at incorrect depth or into very small slits is the cause
	Unnatural/poor hairline	Design hair line skillfully with proper angle, direction and density of grafts
	Edema	Apply tight pressure dynaplast dressing during the surgery and advise the patient to massage the forehead in an outward direction to improve lymphatic drainage
	Necrosis Shock loss or recipient site effluvium	Avoid high densities in smokers, diabetics and cicatricial alopecia Systemic steroids postoperative along with starting minoxidil and finasteride after 2 weeks of surgery prevent this

Key points

1. Due to the progress in hair transplant techniques today, even patients suffering from advanced grades of androgenetic alopecia can successfully be treated giving them an exceptionally natural looking and aesthetic result.^[18]
2. Time management, graft management, and staff management play an important role in a successful surgical outcome.^[18]

In view of the psychological distress caused due to androgenetic alopecia, hair transplantation requires a comprehensive preoperative evaluation to comprehend the patient's expectations. A careful assessment to determine whether surgery is indicated is of utmost importance, to establish realistic goals. If surgery is planned, conscientious attention to minor details, are paid in every aspect of the procedure, so that these goals may be achieved successfully. Nowadays, with the progress in technology, we have reached the level of robotic hair transplant which is not yet available in India. It is a humongous task for hair restoration teams in the coming future, to acquire the necessary expertise for perfecting follicular unit transplantation in giving the best possible results.

ACKNOWLEDGEMENTS

Nil.

Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent.

Financial support and sponsorship

Nil.

Conflicts of interest

There are no conflicts of interest.

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How to cite this article: Chouhan K, Roga G. Hair transplantation in androgenetic alopecia. *Cosmoderma* 2021;1:20.