

Approach to Hair Transplantation in Advanced Grade Baldness by Follicular Unit Extraction: A Retrospective Analysis of 820 Cases

Kavish Chouhan, Gillian Roga, Amrendra Kumar, Jyoti Gupta

Department of Dermatology, DermaClinix–The Complete Skin and Hair Solution Center, New Delhi, India

Abstract

Background: In advanced grade baldness (Norwood 5–7), hair restoration has been considered difficult due to the donor recipient area mismatch. In this article, we have given a comprehensive methodical approach to manage these cases. **Objective:** To assess the outcome and challenges faced with follicular unit extraction (FUE) and to plan a successful management in advanced grade baldness in 820 cases of androgenic alopecia. **Materials and Methods:** A retrospective analysis of 820 male patients with advanced grade of baldness (grade 5–7) treated by FUE. The patients were divided into five groups based on the extent of scalp coverage, for example, frontal coverage, frontal + mid-front coverage, vertex, full coverage, and frontal forelock only. The results were analyzed at 6, 9, 12, and 24 months. **Results:** At 12 months, 94% patients were satisfied with the results, whereas 62% wanted another sitting for increasing the coverage area/density. **Conclusion:** Hair transplantation can give natural and aesthetic results even in advanced baldness. Beard and body hairs can be used to augment results in cases with limited donor supply. A mature hairline with an adequate density in a gradient, from front to back helps in achieving a satisfactory response even in extensive cases of advanced baldness.

Keywords: Androgenic alopecia, follicular unit extraction, hair transplantation

INTRODUCTION

Patients with hair loss have an increased risk of psychosocial and psychiatric morbidity.^[1] For androgenic alopecia (AGA), the only permanent available solution is hair transplant. Follicular unit extraction (FUE) has evolved dramatically as the most recent advancement in minimally invasive surgical hair restoration. Dr. Orentreich, a dermatologist, was the first to describe surgical hair restoration in the 1950s.^[2,3] FUE was first described in 2002 by Inabas, who noted that only the upper third of follicular unit (FU), with the arrector pili muscle attachment needs to be freed by a punch for effective FUE.^[2,4,5] Instead of removing a large area of scalp skin for FU harvest, in FUE, individual FUs are removed from the donor area and prepared for transplantation into recipient scalp. This process leaves little scar, and thus creates a natural, aesthetically pleasing result.^[6] Thus, FUE is a simple surgical technique that serves as an important alternative in the management of advanced AGA where other methods have proved ineffective.

MATERIALS AND METHODS

A retrospective analysis of 820 male patients who underwent FUE for AGA (Norwood G5–7) between 2012 and 2017 at our center was conducted.

Inclusion criteria: All patients with Norwood grade 5–7 AGA, diagnosed by a dermatologist (outside as well as at our center), who underwent hair transplant surgery at our center.

Exclusion criteria:

1. Patients with scarring alopecia and reversible causes of alopecia (e.g., alopecia areata).
2. Patients with body dysmorphic syndrome and unrealistic expectations.

Address for correspondence: Dr. Kavish Chouhan, DermaClinix–The Complete Skin and Hair Solution Center, E13 Defense Colony, New Delhi 110024, India. E-mail: kavish_chouhan@yahoo.com

This is an open access journal, and articles are distributed under the terms of the Creative Commons Attribution-NonCommercial-ShareAlike 4.0 License, which allows others to remix, tweak, and build upon the work non-commercially, as long as appropriate credit is given and the new creations are licensed under the identical terms.

For reprints contact: reprints@medknow.com

How to cite this article: Chouhan K, Roga G, Kumar A, Gupta J. Approach to hair transplantation in advanced grade baldness by follicular unit extraction: A retrospective analysis of 820 cases. *J Cutan Aesthet Surg* 2019;12:215-22.

Access this article online

Quick Response Code:



Website:
www.jcasonline.com

DOI:
10.4103/JCAS.JCAS_173_18

Patients were provided with written information regarding both preoperative and postoperative instructions. The patients were divided into five groups based on the scalp coverage required, for instance, patients requiring frontal coverage, frontal + mid-front coverage, vertex, full coverage, and frontal forelock only. Donor area was assessed to establish its adequacy in the permanent donor zone and extraction was limited to 25% of the permanent hair zone available. In cases where donor area was limited, beard and body extraction was planned. Hence, the basis of categorizing these patients into various groups was dependent on two factors: the availability of suitable donor area as well as the desired coverage area as expressed by the patient. For instance, (1) patients with limited donor supply from scalp, beard, and body were offered frontal forelock only, (2) patients with limited scalp donor supply but adequate beard and body were offered frontal coverage, (3) patients with average donor supply were offered front + mid-front, (4) patients with limited donor supply specifically desiring vertex coverage were offered vertex only, and (5) patients with adequate density and quality of donor supply were offered full coverage. The patient also underwent certain laboratory blood investigations, and their list of regular medications was reviewed to rule out any drugs that may affect bleeding time.

The patient's hair was trimmed short before the surgery. Anxiolytics, painkiller, and antibiotics were administered at the start of surgery. Strict surgical asepsis was taken care of and supraorbital and supratrochlear nerve blocks were given to anesthetize the recipient area. Ring block anesthesia was administered to the recipient area using a combination of xylocaine and bupivacaine. This was followed by the tumescent injection, which was a mixture of lignocaine, bupivacaine with adrenaline, saline/ringer lactate, and triamcinolone acetate. Slits were made using Cut-To-Size blades (Robbins instruments, NJ 07928, USA)

blades of 0.9–1 mm width. Also to determine the depth of the blade, we extracted 2–3 hairs from different areas and kept the blade length accordingly.

Similarly, a ring block anesthesia followed by tumescent solution was administered to the donor area. After this, follicles are extracted using micro motor punches, from the safe donor area. FUs were implanted into the slits using two forceps. All patients received postoperative antibiotic therapy, oral corticosteroids, and analgesic medications. Dressing on the donor area was removed after 3 days. Patients were followed up in the immediate postoperative period, at 3, 7, and 14 days, and then monthly up to 1-year postoperatively.^[7] Follow-up period was 24 months to try and assess the longevity of transplanted hair. Patients were asked to fill up a questionnaire at 12 months, which included their satisfaction level on a five-point scale, any visible reduction in donor area or need for 2nd sitting, and side effects, if any. The patients were required to subjectively rate their satisfaction level using a five-point scale, which was as follows: 1: very unsatisfied, 2: satisfied, 3: good, 4: very good, and 5: excellent.

Challenges faced during hair transplantation by FUE in G5–7 male pattern hair loss

Successful hair restoration in advanced grade baldness has been considered difficult due to the donor recipient area mismatch and various other limitations. Thus, we have discussed in detail the major pitfalls and an efficient strategy to overcome these inadequacies under the following headings [Table 1]:

Donor area management and planning of distribution

Plan a mature hairline and avoid succumbing to impracticable demands by patients requesting further

Table 1: Summary of challenges in hair transplant of advanced grade baldness (grade 5–7) and ways to overcome them

Challenges faced during hair transplant of advanced grade baldness	
Donor area management	<ul style="list-style-type: none"> • Normal permanent donor zone: 10,000–15,000 FU • If 1:4 extraction (25%) maintained: 2500–3500 FU • Beard: 1000–1500 FU can be extracted • Body: depends on quality, thickness, and caliber (in case of limited scalp and beard donor zone)
Time management	<ul style="list-style-type: none"> • Motorized FUE hastens extraction rate to >1000 FU/h + <5% transection rate • Sharp punches of 0.8–0.9mm are preferred • Good tumescence • Adequate magnification and lighting
Graft management	<ul style="list-style-type: none"> • Simultaneous scoring, extraction, and implantation to minimize out of body time • Constant hydration and storage of grafts in specialized solutions • “No touch to root” implantation (to limit damage to hair root/bulb while implantation)
Anesthesia management	<ul style="list-style-type: none"> • Maximum dose: lignocaine (3 mg/kg), lignocaine + adrenaline (7 mg/kg), bupivacaine (2 mg/kg) • Reduce chance of side effects of anesthesia by: <ul style="list-style-type: none"> ◦ planning staged surgery over 2–3 days ◦ tumescence with plain normal saline
Doctor/staff management	<ul style="list-style-type: none"> • Rotation of staff to prevent fatigue • Ergonomic muscle stretching exercises

lowering of the hairline. Give realistic expectations to the patients based on the available donor area. A safe donor area is roughly measured about 6cm from the external occipital protuberance. Thus, the average permanent donor zone is about 10,000–15,000 FU. If the rule of 1:4 (25%) extraction were to be followed, we should get 2500–3500 FU.^[8-10] Assessment of the donor area constitutes gauging the hair follicle thickness, quantity, quality, and caliber as well as documenting the presence/absence of retrograde alopecia or previous scarring of the donor area. An area of 1 × 1 cm was marked out in the donor area and a trichoscan was performed to evaluate the following parameters of hair growth, hair density, hair diameter, and hair quality [Figure 1]. Assessment such as hair count and hair thickness in donor area helps to plan the surgery. On the basis of availability of the donor grafts, we can plan the coverage area that is feasible. For full coverage, a minimum of 6000 grafts, front and mid-front coverage of 4500–5000 grafts, frontal coverage of 3000–3500 grafts, and for frontal forelock, a minimum of 1500–2000 grafts are required approximately.

In patients with advanced grade baldness and a limited safe donor area, we need to augment the donor zone by providing alternate donor areas (e.g., beard/body hair). In most cases, 1000–1500 FU can be extracted from the beard. Body donor hair assessment includes the quality, density, thickness, and caliber of the hair. For instance, in a case where the donor scalp area yields 3000–3500 grafts, we can augment it with 1000 grafts from the beard and thus plan a frontal and mid-frontal area coverage.

The best method of utilizing scalp, beard, and body hair in advanced baldness cases is carried out as follows [Figure 2]:^[11-14]

- The frontal hairline is designed using scalp hair
- The mid-front area is designed using a mixture of scalp and beard/body hair
- The vertex is designed using a mixture of scalp, beard, and body hair



Figure 1: Donor area of 1 cm² for trichoscan assessment

- Body hairs can be used to soften the appearance of hairline and temporal triangles

Time management

Motorized FUE allows for extraction rate of >1000 FU/h with a <5% transection rate. Sharp punches with surrounded edges of size 0.8–0.9mm are preferred over blunt punches.^[15] Good tumescence followed by continuous scoring by the surgeon in sessions followed by extraction of the FUs helps hasten the process without compromising the graft survival. Good quality loupes and adequate lighting are other essential requirements.

Graft management

Simultaneous scoring, extraction, and implantation can be carried out in an organized manner to save time. The extracted grafts need to be constantly hydrated and stored in specialized solutions at all stages. Body donor hair particularly tends to be fragile, finer, shorter, and subject to desiccation injury, thus they require constant vigorous hydration along with less “out of body storage time” of these grafts. The “No touch to root” method of implantation is followed at all steps by the team. The implantation density should ideally be maintained at 35–40 FU/cm² for frontal area with reducing gradient from frontal hairline toward vertex (20–25 FU/cm²). However, certain situations where we ought to be wary of dense packing is in chronic smokers, long-standing grade 7 cases, chronic hypertensives, old age, and female hair transplantation. The hair follicles are distributed in a gradient from front to back with reducing density from frontal hairline to vertex.

Anesthesia management

The anesthetic agents used by us in FUE were 2% lignocaine and 0.5% bupivacaine given in the form of nerve blocks, ring

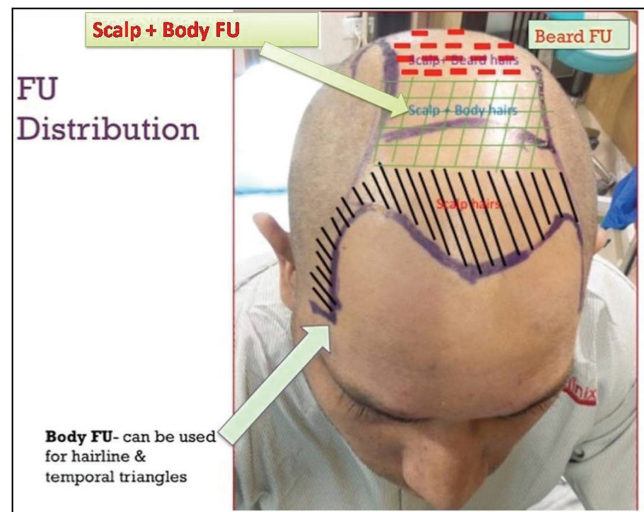


Figure 2: Suggested distribution of scalp beard and body FUs in cases of advanced baldness to achieve better aesthetic outcome

block, and tumescent anesthesia. The maximum safe dose for lignocaine is 3mg/kg and 7 mg/kg with adrenaline, whereas for bupivacaine, it is 2mg/kg. To further reduce the adverse effects related to anesthesia, certain modifications have proved useful, such as planning the surgery over 2–3 days and the use of plain normal saline to reinforce tumescence.

Doctor and staff management

As we know hair transplantation is a team effort, it cannot be accomplished single-handedly. Rotation of doctors and technicians is the key to prevent fatigue. Regular ergonomic muscle and back stretching exercises need to be practiced by both doctors and technicians.

Postoperative management

Postoperatively, the patients were empirically started on a broad-spectrum antibiotic, pain killer, short course of oral steroid, and topical antibiotic. They were instructed to sleep with head slightly elevated to prevent dislodging of the grafts and regular spraying of normal saline on the recipient grafts. They were also asked to remove the donor area dressing after 2 days followed by daily gentle shampooing from day 4 to 10. There was no dietary restriction; however,

patients were asked to refrain from heavy exercise, smoking, and drinking for a couple of weeks. Swelling over the forehead occurs in approximately 25% of patients on day 3 of surgery because of postoperative edema and the presence of large amount of saline injected during anesthesia. This is temporary and can be managed with ice compresses, forehead massages, and administration of a short course of oral steroids. Infection in the form of folliculitis can be managed by empirical use of a systemic/topical antibiotic. In case of persistent crusting, moist saline compresses and frequent shampooing help in dislodging the crusts. Necrosis is best managed by conservative topical antibiotic, topical nitroglycerin ointment, and moist dressings to facilitate separation of the overlying crust.

RESULTS

The implantation density was between 30 and 40 FU/cm² for frontal area with reducing gradient from frontal hairline toward vertex (20–25 FU/cm²). Average number of grafts transplanted were 2982 FU for frontal coverage [Figure 3A and B], 4164 FU for frontal + mid-front coverage [Figures 4 and 5], 2770 FU for vertex coverage, 6237 FU for full coverage [Figure 6A and B], and 1240 FU for frontal forelock



Figure 3: (A) (B) Results of frontal coverage with 3068 FU in one sitting with FUE in case of Norwood grade 5 baldness



Figure 4: (A) (B) Results of frontal and mid-front coverage with 4468 FU (3228 scalp FU and 1240 beard FU) in 1 sitting with FUE in case of Norwood grade 5 baldness after 9 months



Figure 5: (A) (B) (C) Results of frontal and mid-front coverage with 4132 (2956 scalp FU and 1176 beard FU) FU in one sitting with FUE in case of Norwood grade 5 baldness after 9 months

only. Average number of grafts extracted from the scalp per patient was 2956 FU (6320 hair follicles). For groups requiring greater coverage, for instance, frontal + mid-front coverage and full coverage, beard extraction was carried out by FUE with average number of grafts 1100 FU (1500 hair follicles), whereas for group 4 (full coverage) body hairs were also extracted [Figure 6A and B], with average 1500

FU (1650 hair follicles) [Tables 2 and 3]. As far as patient satisfaction score was concerned, it was found to be the highest in the front + mid-front coverage group, followed by frontal coverage (3.8) and frontal forelock (3.4), and closely followed by full coverage (3.3). The minimum satisfaction score was seen in the group of patients belonging to vertex alone. The average satisfaction score (s) in each group was

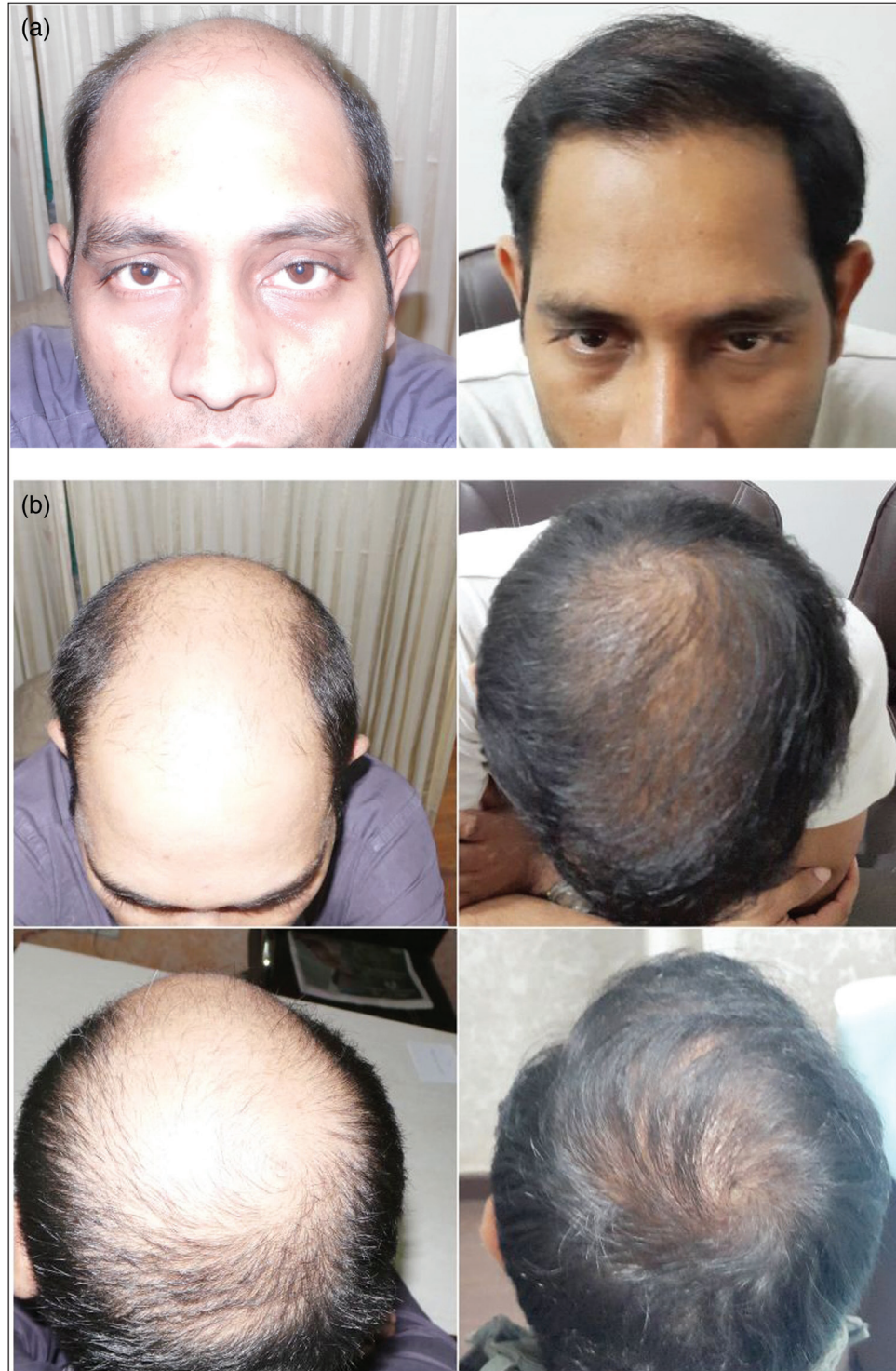


Figure 6: (A) (B) Results of front, mid-front, and vertex coverage with 6337 FU (3557 scalp FU, 1496 beard FU, and 1284 chest FU) in one sitting with FUE in case of Norwood grade 6 baldness after 9 months

as follows: front + mid-front coverage (s = 4.3), frontal coverage (s = 3.8), frontal forelock (s = 3.4), full coverage (s = 3.3), and vertex being the least (s = 2.8).

Most patients demanded full coverage in one sitting, which was not possible in most cases because of the limited donor

Table 2: Average number of grafts transplanted depending on the coverage area

S. no.	Coverage area	No. of patients	Average number of grafts transplanted
1.	Frontal coverage	308	2982 FU
2.	Frontal + mid-front coverage	352	4164 FU
3.	Vertex alone	24	2770 FU
4.	Full coverage	100	6237 FU
5.	Frontal forelock	36	1240 FU

Table 3: Average number of grafts extracted depending on the donor area

S. no.	Donor area	Average number of grafts extracted per case
1.	Scalp extraction	2956 FU (6320 hairs)
2.	Beard extraction	1100 FU (1500 hairs)
3.	Body extraction	1500 FU (1650 hairs)

area; we attempted full coverage (one sitting) in 100 cases that were having very dense donor areas with thick beard (>70 micron) and body hairs (>40 microns). At 12 months post surgery, 94% of the patients were satisfied with the overall results. Also 88% of the patients felt that the donor area looked completely normal and about 62% of the patients opted for a second sitting of hair transplant surgery in order to increase the coverage area/ density. A total of 207 patients completed 24 months follow-up and 9% reported a decrease in density in the transplanted area. The most common complications noticed in this study were postoperative pain, periorbital edema, folliculitis, ingrown hairs, cysts, telogen effluvium (shock loss), excessive persistent crusting, and rarely necrosis. We also had a few patients with seborrheic dermatitis and scalp psoriasis in whom we advised withholding minoxidil a few weeks before the surgery while advocating topical ketoconazole lotion for the seborrheic dermatitis. This is essential as these patients faced excessive crusting, which may affect the results. After surgery, they were further asked to reinitiate the use of minoxidil after 2 weeks along with the treatment for seborrheic dermatitis.

DISCUSSION

Recent advances in FUE have made the management of even grade 7 baldness a reality as have been highlighted in

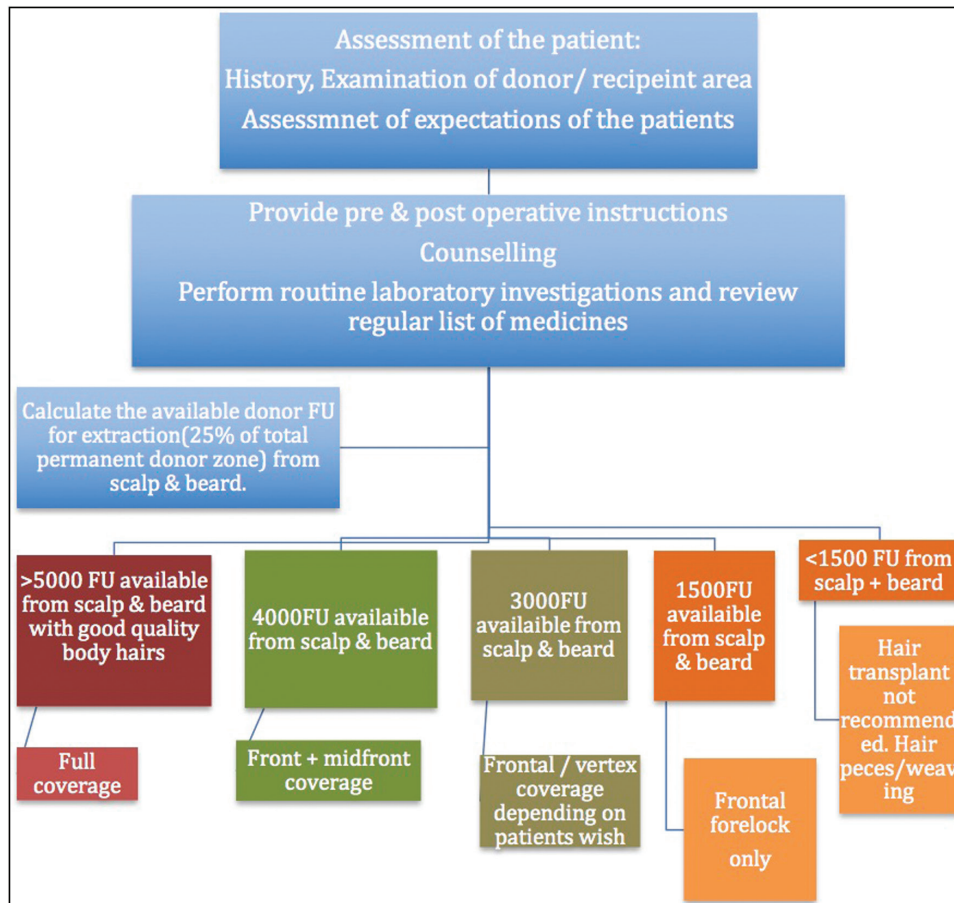


Figure 7: Algorithm to plan area of coverage based on donor area availability

this article. However, the focus of this article has been on the multiple complexities faced and a structured protocol to deal with these glitches during the surgery. The essence of a good result after hair transplant is dependent on planning a mature and realistic hairline based on the donor supply and recipient demand.^[2] The donor hair follicles are assessed for their density, thickness, and caliber, and on the basis of the source being scalp, beard, or body, they are distributed accordingly. Motorized FUE using sharp punches in the setting of good magnification, tumescence, and lighting provides faster extraction rates with minimum transection. Constant hydration of grafts, reduction of their “out of body time”, and the “No root touch” method of implantation enhances their survival rate. Adhering to the maximum dose and keeping in mind the duration of action of anesthetic agents used and limiting the use of anesthesia whenever possible help prevent several complications. Furthermore, ergonomic exercises and rotation of the staff help reduce fatigue among the staff. These key steps if kept in mind can definitely help develop an easy approach to manage these challenging advanced cases while reducing the complications [Figure 7].

CONCLUSION

Hair restoration can give better than satisfactory results even in advanced baldness. Beard and body hair can be used to augment results in cases with insufficient donor area. Mixing with scalp hair for mid-front and vertex coverage best utilize them. A mature hairline with cosmetic density in a gradient from front to back helps in achieving satisfactory response in cases with advanced baldness.

Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent forms. In the form the patient(s) has/have given his/her/their consent for his/her/their images and other clinical information to be reported in the journal. The patients understand that their names and initials will

not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

Financial support and sponsorship

Nil.

Conflicts of interest

There are no conflicts of interest.

REFERENCES

- Ogunmakin KO, Rashid RM. Alopecia: the case for medical necessity. *Skinmed* 2011;9:79-84.
- Rassman WR, Bernstein RM, McClellan R, Jones R, Worton E, Uyttendaele H. Follicular unit extraction: minimally invasive surgery for hair transplantation. *Dermatol Surg* 2002;28:720-8.
- Dua A, Dua K. Follicular unit extraction hair transplant. *J Cutan Aesthet Surg* 2010;3:76-81.
- Harris JA. Follicular unit extraction. *Facial Plast Surg* 2008;24:404-13.
- Onda M, Igawa HH, Inoue K, Tanino R. Novel technique of follicular unit extraction hair transplantation with a powered punching device. *Dermatol Surg* 2008;34:1683-8.
- Bicknell LM, Kash N, Kavouspour C, Rashid RM. Follicular unit extraction hair transplant harvest: A review of current recommendations and future considerations. *Dermatology Online J* 2014;20:3.
- Loganathan E, Sarvajnamurthy S, Gorur D, Suresh DH, Siddaraju MN, Narasimhan RT. Complications of hair restoration surgery: a retrospective analysis. *Int J Trichol* 2014;6:168-72.
- Shapiro R, Shapiro P. Hairline design and frontal hairline restoration. *Facial Plast Surg Clin North Am* 2013;21:351-62.
- Konior RJ, Simmons C. Patient selection, candidacy, and treatment planning for hair restoration surgery. *Facial Plast Surg Clin North Am* 2013;21:343-50.
- Nakatsui T, Wong J, Groot D. Survival of densely packed follicular unit grafts using the lateral slit technique. *Dermatol Surg* 2008;34:1016-22.
- Rassman W, Pak J, Kim J. Follicular unit extraction: evolution of a technology. *J Transplant Technol Res* 2016;6:158.
- Stough D, Whitworth JM. Methodology of follicular unit hair transplantation. *Dermatol Clin* 1999;17:297-306.
- Bernstein RM, Rassman WR. The logic of follicular unit transplantation. *Dermatol Clin* 1999;17:277-95.
- Chang SC. Estimation of number of grafts and donor area. *Hair Transplant Forum Int* 2001;11:101-3.
- Cole JP. An analysis of follicular punches, mechanics, and dynamics in follicular unit extraction. *Facial Plast Surg Clin* 2013;21:437-47.