

Over View of Follicular Unit Extraction

Dua K*

AK Clinics, 2190, Krishna Nagar, Near Aarti chowk, Ludhiana, Punjab, India

***Corresponding author:** Dr Kapil Dua, MBBS, MS, AK Clinics, 2190, Krishna Nagar, Near Aarti chowk, Ludhiana, Punjab-141001, India, Tel: +919815544207; E-mail: drkapildua@akclinics.com

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Abstract

Over the past few decades we have witnessed a tremendous evolution in the field of hair restoration surgeries. It started off with Dr Okuda using 1.00 mm round saws for extracting donor hair and Dr Orentreich using follicular unit hair transplant (FUT), to the very recent Follicular Unit Extraction (FUE) in early part of the millennium. Since the time of its inception in the past two decades, FUE has grown rapidly to account for half of the entire market share. By definition, FUE is a method of harvesting single follicular unit directly from the donor area with the help of micropunches. The principal advantages of this technique are lack of linear scar and quicker postoperative recovery time. This article reviews the principle, techniques, advantages and disadvantages of FUE.

Keywords: FUE; Hair Transplantation; Surgery

Introduction

Follicular unit extraction in its simplest form can be considered as an extension of punch grafting. Hair transplantation can be dated back to Japan where many Japanese surgeons were performing hair transplants before it was ever used in western world.

Dr Shoji Okuda published five series of articles in 1939. He used round saws 1.0-5.0 mm in diameter [1]. Later Hajime Tamura performed many hair restoration surgeries with lot of success using single hair grafts [2]. Dr Norman Orentreich who is regarded as father of modern hair restoration used 4mm punches [3]. The 4mm punch was a compromise and considered best because it was neither too big nor too small. Dr Ray Woods and Dr Angela Campbell claimed to have used small punches to extract but they never published or discussed their technique with their peers. As a result, there was distrust among surgeons regarding their technique.

Dr Inaba did hair harvesting using 1mm punches and he published the concept of single hair harvesting in year 1996 [4]. But Follicular Unit Extraction technique gained popularity after Bernstein and Rassman coined the term "Follicular Unit Extraction" and published this technique in the year 2002 [5]. Since then, this technique has grown leaps and bounds with various new innovations from surgeons across the globe and now contributes up to 48.5% of total hair transplant surgeries [6].

Principle of FUE

Hairs on the scalp are arranged as follicular units [7]. These units are held by arrector pili muscle at the level of isthmus. The principle of intact extraction in FUE is to dissect this arrector pili muscle without damaging the individual hair follicle. Once the muscle is dissected, it is easy to pull the rest of the unit. Depending on the requirement we can dissect required follicular units. The resultant wound is very small and heals by secondary intention. The main disadvantage of this technique is that

it is a blind procedure and the chances of transection are higher in the hands of inexperienced surgeon.

Indications

All hair transplant candidates in general can undergo FUE. But, the authors are mentioning the specific indications of FUE where FUE will be preferred / only choice:

- Patients who want to keep their hair very short, because scar in donor area is very minimal and not visible when compared to linear scar of strip surgery (Figure1).



Figure 1: Donor area after FUE hair transplant after 7 days.

- Patients with tight scalp, where strip width will be a limiting factor.
- Patients with history of keloid formation.
- Patients who have undergone multiple strip surgeries, FUE is the only choice because it's very difficult to harvest another strip.
- For body hair extraction for use in either scalp or other parts of the body (Figure 2).

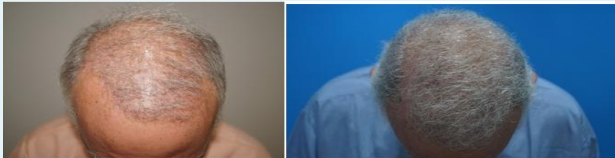


Figure 2: Body HT (Pre op) Body HT (3600 Grafts in multiple sessions from beard and chest after one year)

- FUE is the only choice in eyebrow (figure 3) and beard transplantation (figure 4).

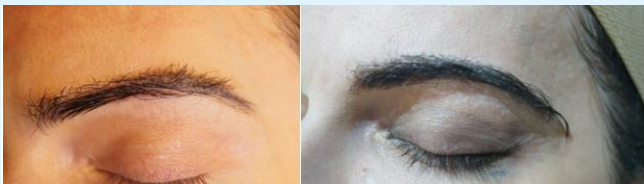


Figure 3: Revision Eye Brow HT (Pre op) Eye Brow HT (100 Grafts after 8 Months)



Figure 4: Beard HT (Pre op) Beard HT (1800 grafts after 8 months)

- Patients who are very apprehensive of pain or scars.
- In patients with limited hair loss, FUE will be very ideal because of less graft requirement (figure 5).

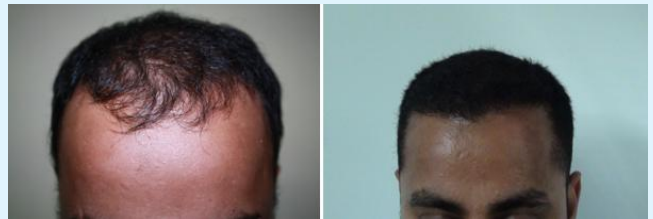


Figure 5: Grade 2 (pre op) Grade 2 (1500 Grafts after 8 Months)

- To maximise the number of grafts obtained in a 1 or 2day surgical session along with FUT.
- In people who want to resume their duties earlier.

Contraindications of FUE

- Technical factors like inexperienced surgeons, inexperienced team, in availability of proper instruments.
- Inadequate donor area.
- Retrograde alopecia

FOX Test

In the beginning of FUE, this test was carried out to determine whether the person is a candidate for FUE or not. This test was based on the tightness with which follicular units are held in the dermis. In FOX test before the procedure the surgeon would extract few grafts from the donor area and evaluate the ease and completeness of follicular extraction. It was classified in to five grades.

Grade 1: When all follicular units were complete, and the graft popped out of the scalp.

Grade 2: The transection rate was 20% or less, first session will be easy but subsequent session was predicted to be difficult because of scarring.

Grade 3: The emergent angle was difficult.

Grade 4: Transection rate was very high with avulsion of the fat surrounding the follicle.

Grade 5: Significant damage in all the grafts

Thus, it was recommended that in FOX grade 4 and 5 FUE should not be performed.

However, with the advancement in expertise and instrumentation available in FUE; FOX test is not being used nowadays as this test does not hold the same value as earlier.

Technical Principles

Magnification: Novice physicians commonly ignore the importance of adequate lighting and magnification while performing FUE. The use of shadow free lights and high quality expanded field surgical loupes with minimum of 4.5X magnification is recommended.

Stability of the Hand: The hands should be very stable while doing the procedure. The punch should be placed accurately over the target area (with the follicle in the centre of the lumen of the punch) as the unwanted movements can easily transect the follicles.

Extraction of the follicles: After the initial step of separating the follicle from its attachment the graft must be pulled with gentle traction one by one without damaging the follicles.

Procedure of FUE

FUE is a type of hair transplantation in which the extraction is different when compared to the strip surgery, but implantation and anaesthesia is similar to strip surgery.

Preparation: After marking the donor area, the hair is clipped using electric trimmer (using 0 size). After clipping, the patient is given head bath with beta dine scrub. If the patient has grey hair before bath, hair dye can be applied. Patient is made to lie prone on the operating chair or table and proper sterilization anaesthesia is given.

Extraction of the grafts: The grafts are extracted using 0.8mm, 0.9mm or 1mm punches. Initially, the FUE started off with manual technique (by two techniques mentioned below) but later on motorized FUE became popular and helped FUE to gain more acceptability amongst the surgeons.

Motorized FUE Tools

FUE extraction tools have undergone significant changes and improvements since FUE first became an available hair transplant technique. (Fig.6) In motorized FUE, harvesting of follicular unit is done by sharp or blunt tipped hollow punch that rotates or oscillates by a motor. The motor is either operated by a button or foot pedal. (Fig.6) Advantages of motorized FUE devices include the ability to extract larger quantities of follicular units per hour resulting in increased session sizes in reduced time and a reduction in fatigue and human error associated with a manual punch. The two most common motorized punches for FUE procedures are:



Figure 6: Handpiece & motor for FUE.

- The Powered Safe Scribe- developed by Dr. Jim Harris, it is equipped with blunt or a dull tip.
- The Powered Cole Isolation Device (PCID) - the PCID developed by Dr. John Cole, unlike Safe Scribe the punches here are always sharp, never blunt.
- The FLAT punch which has been developed by the author (Figure 7).

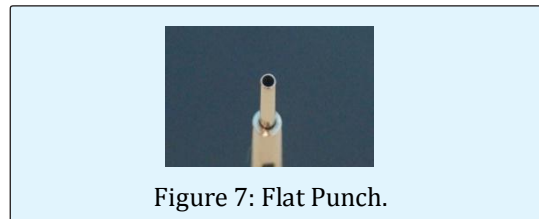


Figure 7: Flat Punch.

Manual Extraction is done with two techniques:

- Two step technique

This technique uses a sharp punch. In the first step, sharp punch is aligned according to the angle of the hair and the skin is scored. The punch should not enter very deep to avoid transection of hair roots. In the second step the assistant will apply gentle traction and pulls out the graft and keeps it in petri dish containing chilled Ringers Lactate. An inbuilt guard in the punch can prevent deep penetration [8].
- Three step technique

In this technique sharp punch is used to score the skin, and blunt punch for deeper dissection. Then the forceps is used for plucking the graft. Using dull punch started decreasing the follicle transection. But there is greater incidence of buried grafts and the procedure is slower.

Harris documented an improvement in graft yield from 92 to 98 percent and hair yield from 74 to 93 percent using three step techniques [9].

However, this three step technique has now been replaced by the motorized FUE and doctors prefer manual extraction with sharp punches only

Post-Operative Care: Donor area is closed with heavy absorbent dressing and removed on 3rd post-operative day. The wounds heal with secondary intention leaving pin point scars.

Complications and Limitations

1. FUE is a blind procedure. In the hands of an inexperienced surgeon, the transection rate is very high.
2. Epithelial capping can happen due to incomplete transection of arrector pili muscle, so when the graft is plucked only epithelium comes out.
3. When using blunt punches, chances of graft burying is very high- to avoid buried grafts avoid nuchal area, clip the hair very short, rely more on twists than on push. Buried grafts can be removed using a comedone extractor otherwise folliculitis may over there in the post-operative phase.
4. Follicular shearing happens when the graft is not separated from arrector pili and it is forcibly pulled out.
5. Graft quality can be compromised by harvesting 'skinny grafts'.
6. Breach of permanent zone while attempting to harvest large number of grafts is a common problem with FUE.
7. Contrary to what most people believe, FUE procedure leaves behind pinpoint white scars in the donor area.
8. Post-surgery donor hair effluvium can happen. It normally presents six weeks after surgery and shows signs of diffuse hair loss [10].
9. Over harvesting from some areas and lesser in the others can lead to Moth-eaten or Pseudosyphilitic appearance¹⁰
10. Infection and necrosis in the donor area can occur if the extraction of grafts has not been spaced out properly [10,11].
11. FUE is very tedious and time consuming
12. There is long learning curve for the surgeon and the technicians.
13. Patient must lie prone for long that can cause lot of discomfort.
14. Finally, since it is very tedious and time consuming, so the procedure is more expensive than the strip surgery.

Robotics in FUE

Since FUE is time consuming there have been attempts to reduce the human effort by automating the technique [12]. ARTAS is a robotic technology for hair transplant designed to improve speed, precision and consistency of follicular unit extraction procedures. ARTAS has its own advantages and disadvantages. Although the ARTAS hair transplant technology has received FDA clearance and many experts believe in its potential to redefine hair restoration, it requires further refinements and would never replace the discernment of a skilled hair restoration surgeon (Figures 8 & 9).



Figure 8: Grade 5 (pre op) Grade 5 (2674 Grafts after 8 Months)



Figure 9: Female HT (pre op) Female HT (1100 Grafts after 1 year)

Conclusion

FUE is a promising advancement in the field of hair transplantation to obtain grafts directly from the donor area. It gives patients an option wearing short hair. But the candidate selection is very crucial as it is not ideal for everyone.

FUE will definitely increase in days to come adding pressure on the surgeon to master the technique with increasing competition, better innovations, and new protocols will come and clinical results will improve.

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