

Follicular Unit Extraction

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Introduction

The follicular unit (FU) was first defined by Headington and the conceptual framework for using FUs in hair transplantation was laid out by Bernstein and Rassman. It became clear to most hair transplantation practitioners that the single-strip harvesting and stereomicroscopic dissection techniques developed by Limmer in 1988 were the best ways to both harvest and isolate FUs.

Although single-strip harvesting is an extremely efficient means of obtaining tissue for subsequent dissection into FUs, it results in a linear scar. Careful technique with thin donor strips will produce very fine scars, but if the strips are taken too wide, the scar can widen to an unacceptable degree. Covering the donor area with longer hair was the only solution to widened scars, as surgical repairs of these wounds generally proved to be ineffective. As a result, a number of patients became hesitant to undergo a procedure that had a potentially difficult-to-treat widened linear scar.

In the mid-1990s, Rassman set out to find a way around this problem by directly extracting FUs from the donor area using a small punch. Early attempts were frustrated by high transection rates in a significant number of patients until Richard Shiell brought the work of Masumi Inaba to his attention.

Inaba's technique varied slightly, using a similar punch but only partially cutting down on the hair follicle and then removing the remainder with forceps. Inaba's insight led to Rassman and Bernstein describing follicular unit extraction or the FOX procedure (Follicular unit eXtraction), outlining an entire hair transplant procedure without strip harvesting.

After performing the FOX procedure on patients of various nationalities it became obvious that extraction proved to be quite variable. Histologic

analysis was used in an attempt to elucidate the cause of patient variability and the FOX Test was introduced, an important surgical recommendation tool to determine patient candidacy.

Overall results showed that the FOX Test classified approximately 60% of all patients as candidates for the FUE procedure. However, even the good candidates had a strong possibility of follicle transection.

Two-Step Technique

This process is comprised of two main steps. In the first step, a sharp 1 mm punch is placed over the follicular unit and aligned to approximate the angle of the hair shafts below the skin surface. A rotational motion of the punch is then used to cut through the skin and isolate FUs in the epidermis and upper dermis.

For a successful procedure, the incident angle of the punch cannot vary much from the hair shaft direction or some, or all, of the hairs in the FU will be transected. Since the hair bulbs in each FU splay outward in the deep dermis and fat, it is also important to limit the depth of the punch to the upper dermis, which proves difficult.

In step two, the extraction, fine rat-toothed forceps are used to apply gentle traction to the top of the FU until the unit is pulled loose from its deep dermal and subcutaneous connections. There is person-to-person variation with this procedure. To help limit variation effects, the technique was refined further, adding dissection when simple extraction proved difficult. If a graft cannot be removed with gentle traction, then the deeper part of the graft is separated from the surrounding tissue through dissection using a fine needle (with a U-shaped tip) while traction is applied with delicate forceps.

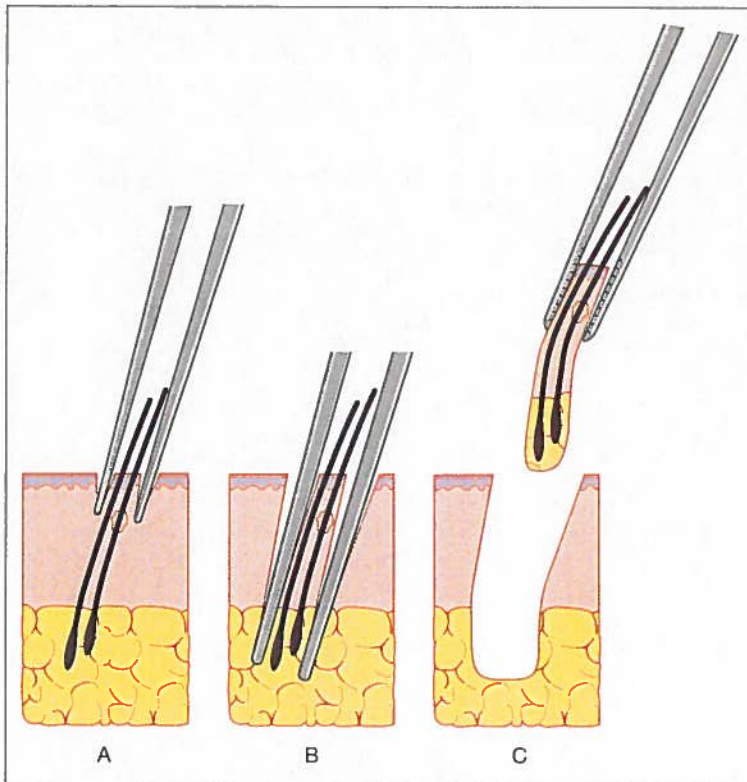


Fig. 17.1 Three-step technique of FUE. (A) The epidermis and upper dermis is 'scored' to a depth of 0.3–0.5 mm with a sharp dermal punch. (B) A 'dissecting' punch is inserted to separate the follicular unit from the investing dermal tissue. (C) The follicular unit is removed with forceps

With this additional dissection step, percentages of positive FOX patients increased. Despite a significant yield improvement, a large number of patients still could not be shifted into 'FUE candidacy.' In many cases transection rates were still unacceptably high and dissection times for significant cases unacceptably long; the additional step slowed the entire process.

Three-Step Technique

James Harris presented a paper and a new solution at an ISHRS scientific meeting, in which he added an additional third step requiring new instrumentation. In this new three-step procedure, a sharp punch is used to score the epidermis (rather than cut through the full thickness to the dermis) and then a dull punch is used (through a back-and-forth twisting motion) to bluntly dissect the FU graft from the surrounding epidermis and dermis (Fig. 17.1).

This variation has several advantages over the original two-step process. Using a dull punch avoids follicle transection and allows intact FUs to be

extracted more easily. As the blunt-tipped punch is advanced into the dermis, splayed follicles are 'gathered together,' avoiding transection. In effect, the dull-punch technique allows a full realization of the 'extraction concept' with an easy-to-learn methodology. One untoward result of the three-step technique is a possible higher incidence of buried grafts, as discussed later. In addition, some of the FUs remain tethered to the subcutaneous tissue and require additional dissection.

One great advantage of this addition was that it opens the technique to the inherent FOX-negative population: those with very fine hair and those with African kinky hair types. Because the procedure is performed blindly, visualization is no longer an issue, potentially increasing yield for those with hard-to-see gray hair. In addition, it appears that this FUE modification has applicability for corrective procedures, removing FUs inside old plugs.

Indications for FUE have evolved considerably. Initially, FUE was limited to FOX-positive patients (that showed minimal transection) and in those in which the size of the balding area matched the surgical team's ability to perform the procedure in

an acceptable time frame – essentially small procedures in select patients. With improved techniques, Rassman reported his largest case yet in 2004: 1903 FUs performed exclusively with the original two-step technique. Harris' modification should allow these large sessions in a greater number of patients.

Nuances of three-step technique

Although the three-step technique is easier to master than the two-step technique, there are certain factors that will increase its efficiency and success.

Because the subcutaneous course of follicles cannot be ascertained with great accuracy, 'scoring' incisions should be limited to a depth of between 0.3 mm and 0.5 mm (approximately the level of the end of the bevel on a standard 1 mm Miltex punch) to decrease the risk of inadvertent transection. However, in patients whose follicles are slightly longer, scoring incision depths may be increased by 0.1–0.2 mm. This increase should facilitate insertion of the 'dissecting' punch and may decrease the incidence of 'buried' grafts.

Even though the use of a blunt punch provides protection for follicles and makes the angle of insertion less critical, follicles may be damaged if the angle is radically different from the follicle's direction. To prevent damage, scoring incisions can be created, and their angles reassessed to obtain a more accurate estimate of the follicle's direction and more accurately 'aim' the dissecting punch.

Follicle separation from the epidermis and upper dermis at the sebaceous gland may occur during extraction. This phenomenon, which has been called 'capping,' can be handled in three ways. If the subcutaneous attachment is significant, a second pass with a dissecting punch can be attempted. A second option is to grasp the unit at the sebaceous gland region and pull, applying a slow, steady force. The final option, if standard dissection fails, is to leave the graft in situ and allow the skin to heal by secondary intention.

Since a third step is required in this new method, the need for efficiency has increased. Rather than performing each of the three steps for each FU in sequence, a preferred method is to identify an area to be extracted, score 25–50 FUs, dissect each one, and then extract. Assistants may help with dissection and extraction but care must be taken to identify any buried grafts for subsequent retrieval efforts.

The need for tumescence varies from patient to patient, but for the most part, it has been found that tumescence may cause the dermis to become somewhat 'mushy' and impede the extraction process. The surgeon must make constant assessments of extraction success each step of the way with every patient. Ease of extraction also seems to vary with scalp location. The occipital area tends to be easier while temporal areas may require manual dissection due to a higher degree of tethering.

Management of buried grafts

As previously mentioned, this technique has an inherent possibility of producing buried grafts. Incidence can vary from patient to patient depending on unidentified skin characteristics. It has been observed that in some patients and in some areas (the temples for example), slightly increasing scoring depths decreases the incidence of buried grafts.

When a buried graft is identified, immediately apply pressure around it in an attempt to 'force' the graft to the surface. If this maneuver fails, the surgeon should examine the circular incision to identify the follicle base, a key step in facilitating removal. If the follicle is not visible, use small, curved forceps with the tip directed towards the 'superior' aspect of the incision in an attempt to grasp the FU. Owing to punch insertion angles, the incision depth is shallower at the superior aspect of the incision. Grafts often invert at this location by tethering to a nonscored attachment.

If the graft still cannot be located, make a small incision towards the superior aspect to create a larger exploratory opening. If after these steps visualization still eludes the surgeon, the graft should be left buried. Exact incidences of graft burial and graft recovery are not available; however, in a 40-patient and approximately 10,000-graft study, only two instances of buried grafts resulted in hair-bearing inflamed cysts requiring removal (Fig. 17.2).

Indications for FUE

FUE is indicated in the following situations:

1. When even a very thin linear scar is unacceptable (i.e. in those who shave their head or wear their hair very short)

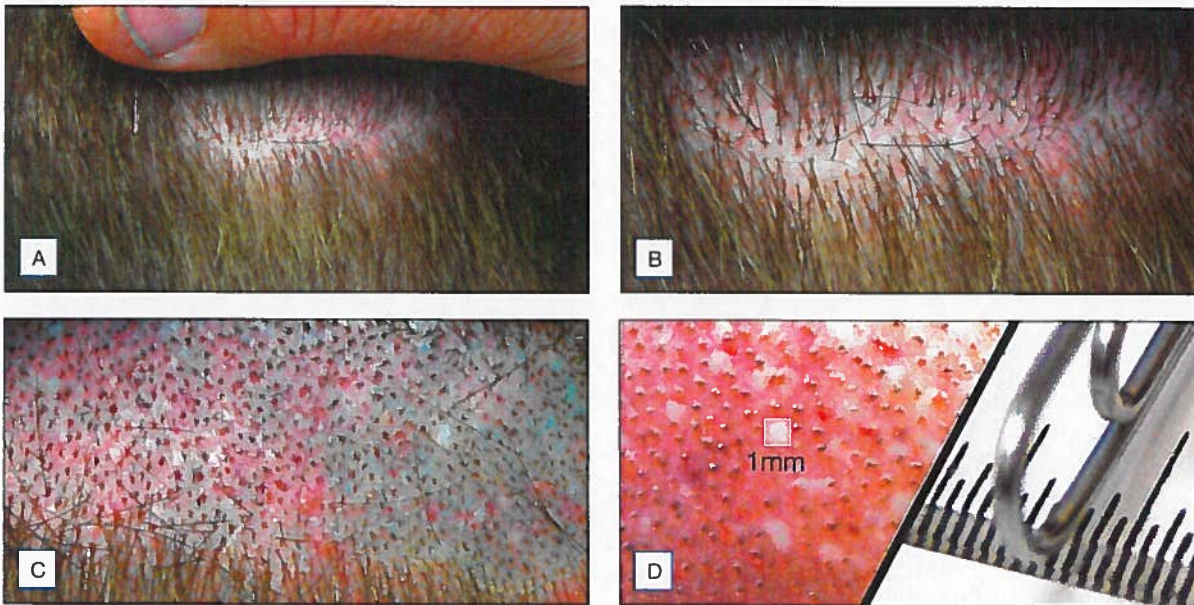


Fig. 17.2 FOX procedure donor scarring: 1 year after ~1600 grafts in two sessions: (A) Normal view with natural short hair. (B) Up close with natural short hair. (C) Up close with clipped hair. (D) Extremely close with clipped hair

2. When a patient requests an FUE procedure and enough grafts can be harvested to meet his or her needs
3. In patients with limited hair loss or those who require small sessions. This group would include patients with male pattern hair loss in a Norwood Class 3 pattern or those with small vertex balding areas
4. For limited cosmetic areas, such as widow's peaks, eyebrows, eyelashes, mustaches
5. For limited areas of alopecia secondary to dermatologic conditions
6. In the treatment of widened scars resulting from traditional strip excisions
7. In patients without adequate laxity for a strip excision
8. For scarring from dermatologic conditions, trauma, or neurosurgical procedures
9. For individuals with heavily scarred donor areas making a linear incision problematic
10. In patients who tend to heal with wide or thickened linear scars
11. In athletes who must resume full activity soon after the procedure
12. For patients with an inordinate fear of pain or scars
13. When the body or beard serves as a donor area.

Contraindications for FUE

Contraindications for FUE include:

1. Inexperience in performing FUE techniques
2. Unavailability of proper instrumentation
3. Inadequate and uninformed patient consent
4. Unrealistic patient expectations
5. Inadequate donor supply
6. Scarring that makes both the two- and three-step procedures problematic.

Conclusion

FUE is an exciting advancement that propels the field of hair transplant surgery one step closer to the elite minimally invasive status. The promise of an almost scarless surgery is enticing to both patient and surgeon. For the surgeon who has to perform this tedious technique, there remain many vague issues ranging from ethical representations of patient results to practical realities of surgical indication. Training periods are extensive, risks of less than desirable results are high, and many technical problems have yet to be worked out.

FUE clearly has a valuable place in a growing number of hair transplant candidates. Although the techniques have improved, issues of patient



Fig. 17.3 Results of FUE. (A–C) Pre surgery. (D–F) 19 months post surgery

selection, donor area healing by secondary intention after large sessions, and imbedded grafts still remain. The reasons for selecting FUE rather than a strip harvest may be the avoidance of a linear scar, the desire for a virtually pain-free recovery period, or simply the idea of having a minimally invasive procedure (Fig. 17.3).

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