

Advances in medicine, as any other endeavor, are intimately dependent upon the communication and dissemination of new information among practitioners. Historically, physicians relayed the art of their practice anecdotally—teaching each subsequent generation verbally. Clearly, with the explosion of technology in the later part of the 20th century, the practice of medicine has also been dramatically and irrevocably altered. Concomitantly, the communication landscape, too, has been changed, evolving from the oral and then the written form into the electronic and digital spheres. In this era of a rapidly changing technology and its immediate access, there lies a significant risk of becoming dogmatic and unilateral in the way we learn and practice medicine.

In an effort to relay current innovations in an open dialogue with debate and exchange of ideas at the same time as maintaining the tradition of sharing experiences with colleagues, we inaugurate a new feature to Dermatologic Surgery. The section, entitled “Controversies in Dermatologic Surgery,” will allow two authors to present opposing philosophy, technique, or approach for the same dermatologic surgical issue. While definitive answers may remain elusive, our goals are to stimulate debate, generate ideas, share pearls and perils, ultimately advance our specialty, and, most importantly, improve the quality of care.

The opinions expressed in these dialogues are those of the author(s), and do not reflect the views of the section editors nor the Journal. We welcome suggestions, comments, questions, and potential topics.

Viva la difference! Please submit your manuscripts to: Seth L. Matarasso, MD, Associate Clinical Professor of Dermatology, University of California School of Medicine, 490 Post Street, Suite 700, San Francisco, CA 94102 or Jeffrey S. Dover, MD, FRCPC, Associate Professor of Dermatology, Harvard Medical School, 25 Boylston Street, Suite 104, Chestnut Hill, MA 02167.

Follicular Unit Hair Transplanting—End of the Evolution or a Good Thing Taken Too Far?

I have used follicular unit hair transplanting (FUHT), one- to three-hair follicular grafts inserted into needle holes, for nearly ten years, in the most noticeable area of a hair transplant: the anterior hairline. This is a relatively small area, so many have chosen to ignore the potential “costs” of FUHT in return for the even distribution and naturalness that this method produces. As an added benefit, these hairline zones have also allowed for comparison in zones that have been treated using a variety of grafts.¹⁻³ The following are the reasons I believe that follicular unit hair transplanting as a sole modality is not always appropriate.

Density

Bob Limmer, one of the “fathers” of FUHT, reported in 1997 that even after four sessions, he could only achieve 81 hairs/cm², compared to a normal hair density of 160–280 hairs/cm².^{2,4,5} If follicles can never be put together again as closely as they once were, why not leave some of them in groups of two, three, or even more follicles, as long as they do not look “pluggy”? “Slit grafts” containing two to three follicles that stand behind each other in a line would also look less “pluggy” than a “follicular family,” consisting of two or three even more closely placed follicles. Some FUHT proponents advocate the latter to achieve

more density with FUHT.⁶ Why is this small amount of plugging of such families acceptable, while that of two to three follicle slit grafts is not? It is true that on very close inspection, with the hair parted, the price of the increased density produced by a combination of follicular units (FU) and slit grafts or small, round grafts is somewhat less even distribution of hair. However, many patients with suitable hair characteristics who began with very little hair in the recipient area have, in fact, been successfully treated with FU and minigrafts (small minigrafts, three to four hairs; large minigrafts, five to six hairs) of various types (Figures 1–3).

Hair Loss

As for the loss of telogen hairs during FU preparation or miscounts of the original numbers of hairs in grafts, I am in some respects reassured by the switch to “chubby” (with greater surrounding tissue) FU from skinny (less tissue around it) FU, and Bechner’s study showing 133% regrowth of transplant follicles.⁷ I say “in some respects,” because this high yield then brings into question the relatively low yield reported in previous studies on hair survival with FUHT. If there actually should be 133 hairs growing from grafts in which only 100 hairs were originally counted, what are we



Figure 1. Pattern of grafts used during first session in this patient included micrografts, small slit grafts, and 133 2mm round grafts.

to think about Limmer's 1997 report in which 95% of hairs grew if the FU were planted within two hours, and 90% grew if they were planted within four hours?⁸ There should be 133 hairs, and instead there were, at the most, 95 hairs! What are we to think of Seager's 89% regrowth at 3-1/2 months (141 hairs from 157 transplanted)?⁹ What degree of scientific rigor was utilized even in this study of a single patient, when four months later Norwood reported on the same Seager patient, but now at 5-1/2 months (and using the same Seager photographs) there were "163 hairs transplanted" instead of the originally reported 141 hairs, for a yield of 113%.¹⁰ Furthermore, studies showing even these supposedly "excellent hair yields" with FU have been carried out in relatively small areas surrounded by areas of intact skin!⁷⁻⁹ Are the results seen here in these grafts comparable to what one would reasonably expect if, instead, the study area were surrounded by typically 1,000 or more addi-



Figure 2. Patient before treatment. His fine textured medium brown hair and some persisting hair in the recipient area, minimized post-operative noticeability.



Figure 3. Patient one year after the third session to the front. Treatments were scheduled with one-year intervals and despite the types of grafts utilized, and less than solid filling of the zone treated with 2 mm grafts, he insists that *nobody*, including his wife of two years, has noticed he's been undergoing hair transplanting.

tional skin incisions, as they are during actual treatments? If I studied hair survival in four or five 4.0 mm standard grafts (containing 80-90 hairs) in the middle of an otherwise untreated recipient area, who would accept these results as valid? Such FU studies that have been quoted ad nauseum as "proof of superior hair yield" with FUHT may be practical, but they are a completely scientifically invalid, and especially so in the usual clinical situation.

Viability

Thus, by far, the most serious reservation I have about FUHT is my concern that survival of donor hair is decreased rather than increased by FUHT. Follicular units have much less protective tissue around them than the surrounding follicles in minigrafts, rendering FU more susceptible to lethal injury during their preparation from the donor strip, dehydration while awaiting their insertion into the recipient site, and physical trauma during their insertion. It is now generally agreed upon by FUHT proponents that follicles harvested and prepared properly with elliptical excision/microscopic dissection (EEMD) contain an average of between 2 and 2.2 hairs/follicle.¹¹⁻¹³ In 1996, Limmer used a density of 20-30 grafts/cm² "in most typical cases."¹⁴ If one needed an average of 25 grafts/cm², how then does one reconcile his reported 41 hairs/cm² growing after the first session with the 50-55 hairs (25 × 2, or 2.2) that should have grown?⁴ Seager's 1996 article reported that he used 40 FU/cm². This should have produced 80-88 hairs/cm² (40 × 2, or 2.2), or nearly half normal density. Beside the fact that nobody has ever claimed to produce such densities in a single session, Limmer took four sessions to

do this at that time. Furthermore, the studies of Seager and others who claim to produce approximately 20% more follicles from the same amount of donor tissue if they used EEMD are in every case based on only one or a few patients, and are scientifically flawed—not only by the small number of patients studied, but most importantly, by the practical difficulty of actually finding two pieces of donor tissue that really began with exactly the same number of FU/hairs rather than being the “same size.”⁹ EEMD is no doubt an excellent method of FU graft preparation, but, as usual, its benefits have been exaggerated by its proponents.

Technique

Lastly, FUHT is probably the most technician-dependent procedure in surgery. The safe preparation and insertion of FU is technically more demanding than the preparation and insertion of minigrafts. But the technicians in most centers are extremely mobile. One of the most common questions one hears at hair transplant meetings is, “How do I get good technicians and keep them?” Even in clinics with photographs of good results, how does the potential patient know they are getting the same technicians that produced the results they were shown? Furthermore, it is often the technicians who choose hair angles, directions, and densities. In some localities this may be satisfactory, but patients have good reason to doubt the consistency of results.

Conclusion

FUHT is a part of an evolution in hair transplanting, but in my opinion it is not “the end of the evolution.” It has many advantages, but its “costs” are variable and almost certainly are higher than we have been led

to believe. The latter should not be brushed aside as merely “pseudoscientific rationalizations” of those who oppose change, when, in fact, the reverse seems to be happening—those proposing the change to exclusive FUHT are doing the pseudoscientific rationalization.¹⁵

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References

1. Unger W. Different grafts for different purposes. *Am J Cosmet Surg* 1997;14:177-83.
2. Unger W. “The density issue”—my absolutely last words on this overdone subject. *Hair Transplant Forum Int* 1998;8:25-6.
3. Unger W. The telogen war: the “condemned” replies. *Hair Transplant Forum Int* 1999;9:22-4.
4. Limmer B. The density issue in hair transplantation. *Dermatol Surg* 1997;23:747-50.
5. Headington JT. Transverse microscopy anatomy of the human scalp. *Arch Dermatol* 1984;120:449-56.
6. Seager D. Dense hair transplantation from sparse donor area—introducing the “follicular family unit.” *Hair Transplant Forum Int* 1998;8:21-3.
7. Beehner M. A comparison of hair growth between follicular-unit grafts trimmed “skinny” vs. “chubby.” *Hair Transplant Forum Int* 1999;9:16.
8. Limmer BL. Micrograft survival. In: Stough D, ed. *Hair replacement*. St. Louis: Mosby, 1996:147-9.
9. Seager D. Binocular stereoscopic dissecting microscopes: Should we all be using them? *Hair Transplant Forum Int* 1996;6:2-5.
10. Norwood OT. Limmerization. *Hair Transplant Forum Int* 1996;6:12.
11. Bernstein R. Measurements in hair restoration. *Hair Transplant Forum Int* 1998;8:27.
12. Bernstein R. Rassman W. The logic of follicular unit transplantation. *Dermatol Clin* 1999;17:277-95.
13. Jimenez F, RUIFERNANDEZ J. Distribution of human hair in follicular units. *Dermatol Surg* 1999;25:294-8.
14. Limmer BL. Thoughts on the extensive micrografting technique in hair transplantation. *Hair Transplant Forum Int* 1996;6:16-8.
15. Marritt E. A history lesson. *Hair Transplant Forum Int* 1999;9:20-2.

In Support of Follicular Unit Transplantation

The Logic of Follicular Unit Transplantation

Follicular Unit Transplantation is a method of hair restoration surgery where hair is transplanted exclusively in its naturally occurring, individual follicular units. Specifically, single strip harvesting, stereo-microscopic dissection, and large transplant sessions will be reviewed.

A donor is better if it as small as possible. The reason is that if a donor is big, hairs grow in . . . a very unnatural appearance.

Hajime Tamura - 1943¹

Preservation of the Follicular Unit

This underlying premise of follicular unit transplantation is that the intact, individual follicular unit is sacred. Theoretically, they should neither be broken up into smaller units, nor combined into larger ones.²⁻⁴

This simple idea may not seem like a radical approach to hair transplantation, but when viewed in the context of how the surgery has been performed over the past forty years (when the very existence of the follicular unit went generally unrecognized), it is radical indeed. At present, the majority of hair trans-

plant surgeons will, at times, combine several follicular units or split them up, as they are not convinced that this has a significant impact on either the aesthetic outcome or upon growth. Practitioners of follicular unit transplantation, however, are certain that only this procedure achieves the best cosmetic results and their hair “bristles” when they witness surgical techniques that divide follicular units or transect follicles, techniques they feel preclude optimal growth and waste precious donor hair. In spite of the heated debate, good scientific studies have not yet been performed to resolve these issues.

The follicular unit was first defined by Headington in his landmark 1984 paper “Transverse Microscopic Anatomy of the Human Scalp.”⁵ The follicular unit includes 1 to 4 terminal follicles, 1, or rarely 2, vellus follicles, associated sebaceous lobules, insertions of the arrector pili muscles, perifollicular vascular plexus, perifollicular neural net, and perifolliculum—circumferential band of fine adventitial collagen that defines the unit (Figure 1).

Transplanting Individual Follicular Units

That scalp hair grows in follicular units, rather than individually, is most easily observed by densitometry, a simple technique whereby scalp hair is clipped to approximately 1 mm in length and then counted via magnification. What is strikingly obvious when one examines the scalp by this method, is that follicular units are relatively compact, and are surrounded by substantial amounts of non-hair bearing skin. The ac-

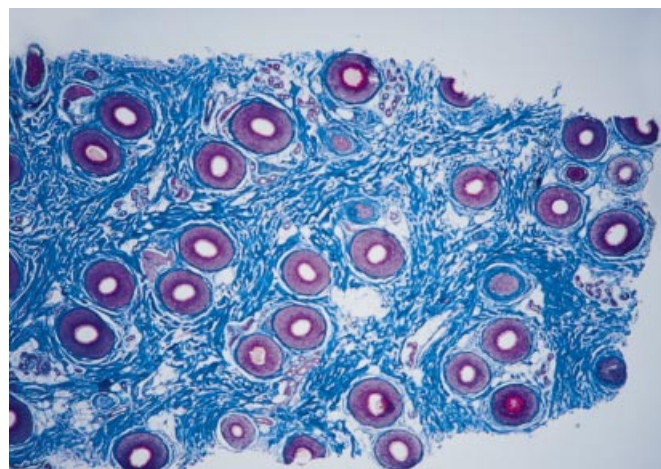


Figure 1. Follicular units at the level of the papillary dermis above the entry of the sebaceous duct. Each hexagonal follicular unit encloses sebaceous glands, sebaceous ducts, and several terminal and/or “vellus” hairs. Trichrome staining demonstrates pink keratin, smooth muscle, and blue collagen. Photo courtesy of Dr. David Whiting.

tual proportion of non-hair bearing skin is probably on the order of 50%, so that its inclusion in the dissection will have a substantial effect upon the outcome of the surgery. The great benefit of using individual follicular units is that the wound size can be kept to a minimum, while at the same time maximizing the amount of hair that can be transplanted.

Small Recipient Sites

The importance of minimizing the wound size in any surgical procedure cannot be overemphasized and hair transplantation is no exception. The effects of recipient wounding are felt at many levels. Large wounds can lacerate blood vessels and although the blood supply of the scalp is extensively collateralized, any damage to these vessels will have an impact on local tissue perfusion. An equally important issue is to minimize the disruption of the microcirculation. This is especially important when transplanting grafts in large quantities. The compact follicular unit is, of course, the ideal way to permit the use of the smallest possible recipient site, and has made the transplantation of large numbers of grafts technically feasible.

Densities between 10 to 40 follicular units per centimeter are routinely reported. Densities greater than 40 follicular units per centimeter in a single session have been accomplished, but may result in a decreased yield in some patients. It is important to note that a follicular unit density of 40 units/mm² can create a hair density of over 120 hairs/mm² (if all three- and four-hair units are used in select areas), and this is a density that many hair transplant surgeons feel is not necessary, or even desirable, to exceed.

Transplanting Follicular Units in Large Sessions

Putting aside anatomic, physiologic, and technical issues for the moment, it is important to emphasize the practical reasons to strive toward large sessions. The specific events that bring a balding patient to the doctor for hair loss will vary, but the common denominator of those seeking hair restoration is to improve their appearance and to improve the quality of their life, be it personal, professional, or social.

Until the transplant is cosmetically acceptable, the disruptions from the scheduling of multiple surgeries, the limitations in activity, and the concern about their discovery, can place a patient’s life “on hold.” It should therefore be incumbent upon the physician to accomplish their objectives as quickly as possible. Some patients prefer smaller sessions for economic reasons.

Microscopic Dissection

There is probably no other aspect of follicular unit transplantation that has generated more controversy than the use of the microscope. Stereo-microscopic dissection was introduced into the field of hair transplantation by Dr. Bobby Limmer⁶ in 1987. The following statements summarize the use of magnification:

- In order to dissect intact individual follicular units, you must be able to see them clearly.
- Only magnification allows their clear visualization in both normal and scarred skin, independent of the specific hair characteristics of color, hair shaft diameter, and curl.

Follicular dissection can logically be divided into two parts: the subdivision of the initial donor strip into smaller pieces and the further dissection of these pieces into individual follicular units. The first part of the procedure, the handling of the intact strip, has always been the most problematic. The intact strip, however, is difficult to stabilize and is too opaque for transillumination to be useful.

The dissecting microscope and other magnification methods allow the strip to be divided into sections (or "slivers") by actually going around follicular units leaving them intact. The dissecting stereo-microscope is able to accomplish this because of its high resolution (usually 5× more powerful than magnifying loops) and its intense halogen top-lighting that provides continuous illumination, as one dissects through the strip. Back light illumination has also proven beneficial. Stability can easily be achieved by applying slight traction to the free end of the strip. The thin slivers are then laid on their sides and the microscopic dissection of the individual units is completed. With stereo-microscopic dissection, except for the outer edges of the ellipse, every aspect of the procedure is performed under direct visualization, so that follicular transection can be minimized and the follicular units maintained.

Conclusion

The entire field of hair restoration surgery has moved toward the use of follicular unit transplantation. While the exclusive use of follicular units is not employed by the majority of transplant surgeons, the impact of this approach has been significant. Hair restoration surgeons are becoming more scientific and precise in their approach to this field. The vague terminology of the past, ie, round grafts, many grafts, micrografts, has been replaced with more precise terms. We now converse in a language which details the number of follicular units per square centimeter, hair shaft diameter in microns, and incisional density of the recipient site for any given session. Perhaps the modern era of transplantation did not begin with the micrografting of the 80s, but it is only truly being realized with Follicular Unit Transplantation of the 90s.

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References

1. Tamura H. Hair grafting procedure. *Jpn J Dermatol Venereol* 52:1943.
2. Bernstein RM, Rassman WR, Szaniawski W, Halperin A. Follicular Transplantation. *International Journal of Aesthetic and Restorative Surgery* 1995;3:119-32.
3. Bernstein RM, Rassman WR. Follicular transplantation: patient evaluation and surgical planning. *Dermatol Surg* 1997;23:771-84.
4. Bernstein RM, Rassman WR. The aesthetics of follicular transplantation. *Dermatol Surg* 1997;23:785-99.
5. Headington JT. Transverse microscopic of the human scalp. *Arch Dermatol* 1984;120:449-56.
6. Limmer BL. Elliptical donor stereoscopically assisted micrografting as an approach to further refinement in hair transplantation. *Dermatol Surg* 1994;20:789-93.