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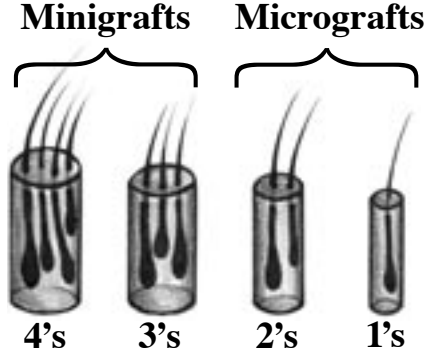
Follicular Unit Micrografting

By the early 1990s, some hair restoration surgeons had began to regularly cut full size hair transplant grafts into quarters to form minigrafts having three to five hairs each, and entire transplant procedures were done with these minigrafts. Many small round holes were made on the scalp to receive the minigrafts. Minigraft hair transplants had the potential to look more natural than procedures done with larger full-size grafts. However, graft failure rates were initially higher with this new procedure than with full-size grafting.

Improved surgical techniques helped improve small graft survival rates, and soon the procedure evolved further to even smaller micrografts containing only one to three hairs each. This was the beginning of micrograft hair transplants. The method of harvesting donor follicles changed as well. Instead of removing dozens of small pieces of tissue from the back of the scalp, and then cutting these into even smaller pieces, all the donor follicles were removed at one time in the form of adjacent strips of tissue using a multi-bladed scalpel.

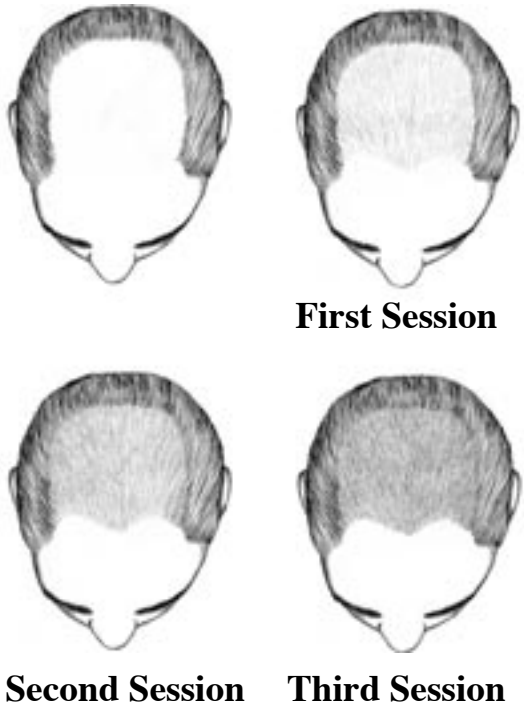


Classification used in early 1990s.

Teams of medical assistants then cut 1,000 or more individual micrografts from

the strips of donor material, using magnifying loupes and glasses. Even with several assistants, micrograft preparation takes several hours, and graft placement takes much longer as well. A micrograft procedure can take a full day, in contrast to a few hours for a full-size graft surgery. But the improved results over full-size grafts and minigrafts were worth the time and effort, and by the early 1990s micrografting became the new standard for surgical hair restoration. A variation of micrografting called follicular unit micrografting continues to be the most popular method of surgical hair restoration in use today.

Micrografting offers numerous advantages over other surgical hair restoration techniques, including full-size graft procedures, scalp reductions, and scalp lifts and flaps. Among the benefits are more natural appearing results, a very short "under construction" period, and each micrograft procedure stands alone, thereby giving both the doctor and patient increased flexibility in addressing the hair loss



A series of follicular unit micrograft procedures

condition. Micrografting is a relatively safe procedure, and medical complications or poor cosmetic results are rare.

Achieving more natural appearing results is the primary goal of all elective cosmetic surgical procedures. Micrografts give the surgeon the greatest flexibility in graft placement so that a very natural look can be achieved. Micrografts can be placed between existing hairs, allowing a patient who is just beginning to experience hair loss to increase his or her hair density, and never have that "balding" look. For patients who already have bald areas, a single micrograft procedure will change them from looking like they are losing their hair to an appearance of just having "thin hair." Subsequent procedures can add density, until a "full head of hair" look is achieved.

In addition to appearing more natural than full-size grafts, skillfully placed micrografts can allow for a more effective illusion of having more hair. Colorado hair restoration surgeon Dr. Jim Swinehart considers each graft to be a "visual unit." A single full-size graft having fifteen hairs is like a large tree standing alone in front of a house. The same number of hairs broken up into eight micrografts creates eight "visual units," which can be compared to a quantity of eight bushes spread in front of a house. When the same quantities of hairs are spread out with smaller grafts, they give the appearance of more coverage.

Incisions made for micrograft procedures heal very quickly in comparison to other surgical methods of hair restoration, resulting in a very short "under construction" period. The donor area is closed with a single fine line of sutures, and is well camouflaged by the thicker hair at the back of the head. The recipient sites where the grafts are placed are fine slits made with a miniature surgical blade, and these heal very rapidly. Many micrograft patients return to work a day or two after the procedure, and no one is aware of the work that was done. This is in contrast to the two weeks or longer for healing that is allowed for full size grafts and for incisions made for scalp reductions, lifts, and flaps.

Each micrograft procedure is designed to stand alone, meaning that no additional procedures are required, and that the transplanted hairs will look natural decades in the future even as hair loss progresses. By placing micrografts over the entire balding surface of the

scalp, as well as between growing hairs in adjacent areas that will likely lose hair, a skilled surgeon will avoid creating an "island" of dense hair surrounded by thinning hair as hair loss continues years in the future. Micrografting allows for additional procedures to be performed, as the patient desires.

I have had some patients express a desire for the densest possible coverage, anticipating several successive micrografting procedures; however, after a single procedure grows out they are satisfied with their new hair just the way it is. And I've also had patients who initially indicate they want only a single procedure, with just enough coverage to give them some hair on the top or on the back of their heads. Then after a single procedure, they decide to have a few more, in order to achieve maximum density. Micrograft transplants allow for this flexibility.

This is in contrast to the original large grafts (plugs), which required the full series of procedures to fill in the spaces between grafts in order to avoid the "doll's hair" look. With original large plug grafts, if the patient elected not to have all the recommended procedures done, the transplant looked unfinished. Or, if the surgeon miscalculated the degree of future hair loss, an island of dense hair may emerge as the surrounding fringe receded. Micrografting is also employed to enhance previously performed full size graft procedures, as well as to cover scars from scalp reductions, scalp lifts, and flap procedures.

Micrografting is a safe procedure, both medically and cosmetically. In contrast to more elaborate hair restoration techniques such as scalp lifts and scalp flaps, micrografting has a low risk of medical complications. Unlike scalp lift and flap procedures, with micrografting the patient does not receive general anesthesia, and is awake during the entire procedure. General anesthesia alone presents a significant risk of medical complications, and is avoided entirely with micrografting. Other medical complications, while always a possibility with any surgical procedure, are rare with micrografting.

In addition to being medically safe, micrografting is a safe cosmetic procedure as well. A single micrografting procedure almost always produces excellent or very good appearing results, and even a poor micrograft transplant is usually cosmetically acceptable and can

be enhanced or corrected. In contrast, more elaborate scalp lift and flap procedures can produce remarkable results with a single surgical session; however, they can also produce disastrous cosmetic results when everything does not go right. Patches of dead scalp tissue and large unsightly scars are examples of complications that have occurred with scalp lifts and flaps.

During the 1990s, many variations of micrografting emerged, with each technique claiming to have special advantages. Examples of variations in micrografting included monografting, megasessions, the use of graft cutting and placement machines, laser hair transplants, and follicular unit micrografting.

Monografting

Monografting was the exclusive use of single-hair grafts. It seemed to be a natural evolution from the original full-size pluggy grafts containing up to fifteen hair follicles, to minigrafts having three to five hairs, to micrografts having one to three hairs. The theory was that individually placed hair follicles would give the most natural appearance of all. With this procedure, single-hair grafts were meticulously sculpted to almost bare follicles, and then placed into tiny recipient sites usually made with a surgical needle. Unfortunately, the extensive cutting that was necessary to isolate individual hair follicles resulted in a loss of many donor follicles and a relatively high graft failure rate, and the appearance of the surviving grafts was one of overall fuzziness that did not look natural.

Megasessions

The first megasessions were another variation of micrografting in which the donor material was cut into 1- and 2- hair grafts, and 2-3,000 or more grafts were placed in a single session. The idea behind megasessions was to solve a patient's hair loss problem in a single surgical procedure. The problem was that each graft had to be trimmed extensively, and the grafts had to be placed very close together. Most of the grafts were 1- and 2-hair grafts, many created from 3-hair grafts. The excessive cutting increased the risk of graft failure from the rough treatment of the thousands of individual grafts. Initially, most responsible hair restoration surgeons avoided placing more than

2,000 grafts in a single session in order to reduce risk to the limited supply of donor follicles. As the techniques improved, the number of grafts per session increased up to 5,000 grafts in one session.

Graft Cutting and Placement Machines

Because of the length of time and large number of medical assistants needed for micrograft procedures, some early attempts were made to increase efficiency with technology through the use of specialized hair transplantation machines. One device was a "graft-cutting machine" that sectioned the strips of donor tissue into uniform "grafts," in much the same way that a hard-boiled egg slicer would slice an egg into uniform pieces. While this device saved a considerable amount of time and labor, it could cut the tissue without regard to where the hair follicles were located, or their angles of orientation. There was a higher percentage of transection, or cutting of the hair follicles. While some of the sliced hair follicles survived, and on occasion two halves even survived and regrew as two small hair follicles, many more perished, and the device never caught on. Only a few hair transplant surgeons have used graft-cutting machines successfully, and typically with patients having very straight coarse hair. I had the opportunity to see this procedure done by a good hair transplant surgeon using only one assistant. The results were very good. The main drawback to this procedure is that more hairs are lost in the preparation and the patient should have straight hair.

Another attempt at automation was a hand-held graft implantation device that was first loaded with uniformly cut grafts, which the machine then placed into the patient's scalp in much the same manner as a carpenter's nail gun places nails into a roof. The machine pierced the scalp and inserted the graft in one step. In addition to either requiring the aforementioned machine-cut grafts, or very carefully hand-cut grafts, this machine did not seem to actually save much time, and it never became very popular. When used to place the grafts close together, the automatic implanters tend to push out the grafts next to them. More accurate and more densely placed grafts could be accomplished by using a fine blade to make the incision and tedious, meticulous placement using two forceps by experienced placement surgical technicians.

Laser Hair Transplants

Another high-technology micrografting technique was laser hair transplants. The donor material was harvested the same way as for other micrograft procedures, but the recipient sites were made with a laser. The most sophisticated laser hair transplants used computerized scanning devices to make tiny slots for each graft. A problem inherent with using a laser is thermal damage to the cells surrounding the opening made by the laser. Lasers vaporize tissue, and many layers of cells suffer damage from the heat. Grafts placed into laser slots also heal more slowly, and the patient looked "under construction" for a considerably longer time than with other micrografting methods. Some laser transplant surgeons claimed that the recipient slots made by the laser resulted in a more "natural" graft than slits made with steel instruments; however, most surgeons could not perceive a benefit, and certainly not when weighed against the considerable expense of buying or leasing the laser. Laser transplantation allowed for high technology advertising claims, but the procedure never really caught on.

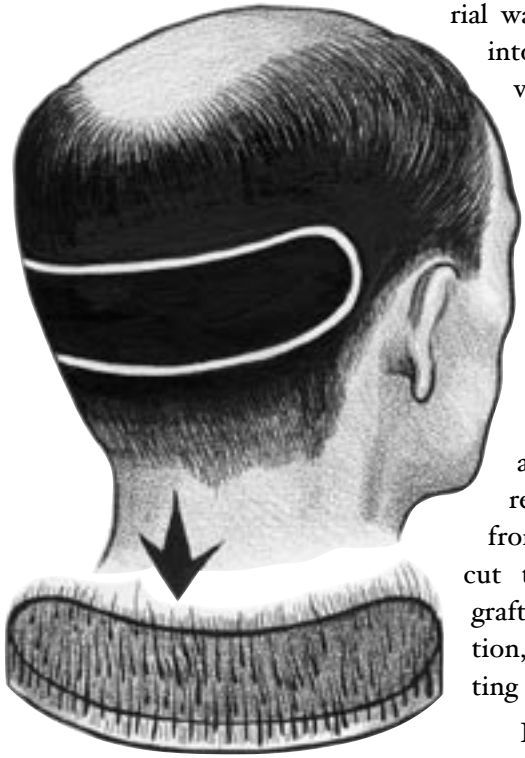
Follicular Unit Micrografting

By the mid 1990s, micrografting evolved into follicular unit micrografting, which is currently considered the state-of-the-art method of hair transplantation. The emphasis of this technique is twofold. The first is maximizing the yield and survival of the limited supply of donor hair follicles throughout every stage of the surgical procedure. The second is on achieving the most natural-looking results possible. Many subtle refinements of the micrografting surgical technique comprise a follicular unit transplant procedure, and combined together these refinements give the best possible results.

The first way in which a follicular unit micrografting procedure may differ from some of the micrografting variations of the past is careful planning to avoid harvesting too many grafts for a single transplant session. Almost every patient wants as much hair density added in as few sessions as possible; however, placing too many micrografts too close together increases the risk of graft failure. Despite the ability to harvest and place many more grafts, a follicular unit micrograft

surgeon will choose to do only 1,000 to 2,000 grafts in a single session. The main limitation to the number of grafts per session is the issue of supply and demand. In most patients with extensive balding the donor area is usually much less dense as well as being smaller in size. The patients with very dense donor hair in the back usually are not very bald. I would estimate that only one patient in one hundred would be a candidate for 5,000 grafts, two in a hundred may qualify for 4,000 grafts leaving the majority getting 1,000 to 2,500 per session.

The donor material harvesting method is another refinement that has become a standard part of follicular unit micrografting. In the past, many surgeons used a multi-bladed scalpel to remove the donor tissue from the back of the scalp. All the blades in this surgical instrument were parallel, and were set about three millimeters apart. With a multi-bladed knife, the donor material was removed already cut into long strips, and individual grafts were then more easily cut from the strips. This method caused many hair follicles to be cut by the scalpel blades, and a high percentage of these cut follicles did not survive. Follicular unit surgeons now use a single-blade scalpel to remove the donor tissue from the scalp, and then cut the donor tissue into grafts under high magnification, working to avoid cutting the hair follicles.



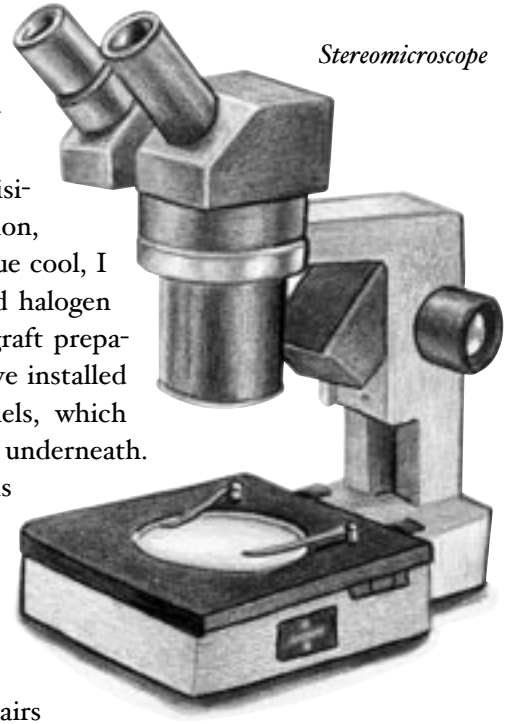
Donor material is removed from the patient.

Immediately after the donor material is removed from the patient, it is

immersed in cold saline solution to bring down the temperature of the follicles, and thereby increases graft survival. A few hours can elapse from the time the donor tissue is removed to when a particular hair follicle is placed into the scalp, and keeping the follicles cool and moist helps them survive better during this time. After the grafts are cut they are placed onto surgical pads moistened with saline solution, and these pads are placed into trays that are chilled as well.

The use of stereomicroscopes to cut the donor material into grafts is another standard component of follicular unit micrografting. In the early stages of micrografting, eye loupes and magnifying glasses were commonly used to aid the process of cutting donor tissue into strips and pieces, and eventually into individual grafts; however, a considerable number of hair follicles were cut due to poor visibility even under high magnification.

Stereomicroscopes have separate eyepieces for each eye, which allows for a more three-dimensional view of the donor tissue. Stereomicroscopes require additional training for the team of medical assistants who cut the grafts; however, their use results in less follicle transection, meaning they avoid splitting hairs.



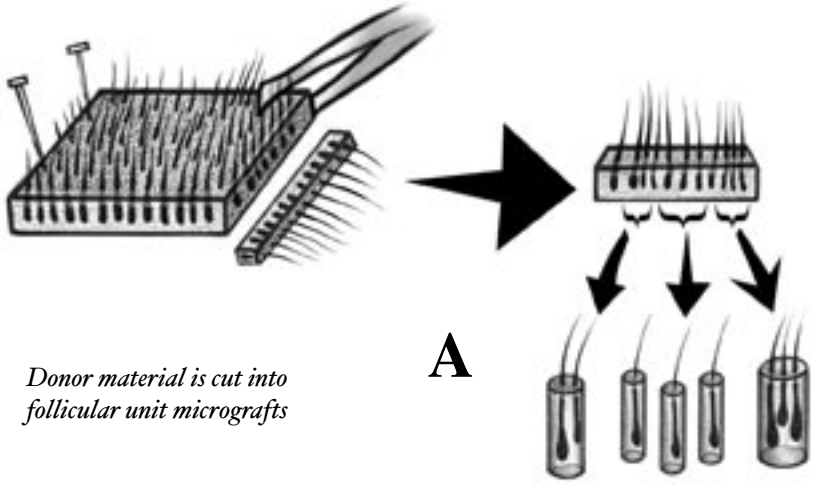
Stereomicroscope

To further improve visibility during graft preparation, and to keep the donor tissue cool, I have removed the standard halogen spotlights from all of my graft preparation microscopes and have installed cool fluorescent light panels, which illuminate the grafts from underneath. This lighting technique is called transillumination. Cool fluorescent transillumination helps to make small dormant hair follicles and follicles containing very fine light-colored hairs

more visible, further increasing yield. This lighting enhancement also avoids heat damage to the donor tissue that incandescent lighting from the overhead can cause.

The most significant of all micrografting refinements, and the concept that gives the follicular unit procedure its name, is the preservation of the naturally occurring clusters of hair follicles during graft preparation. Transplant surgeons have observed that many hair follicles on the scalp occur in pairs or bundles of three or four follicles, which are called follicular units. Preserving follicular units intact as micrografts reduces the risk of inadvertently cutting follicles occurring close together, which results in grafts growing more viable hairs, and also produces grafts that grow hairs in more natural clusters.

In the early years of micrografting procedures, the hair restoration surgeon would develop a plan for the quantity and size of the hair grafts for a particular procedure. The team of medical assistants may have been instructed to produce 600 single-hair grafts, 500 2-hair grafts, and 400 3-hair grafts for a procedure calling for 1,500 total grafts. The team of medical assistants then cut grafts from the donor tissue according to the surgeon's requirements, and if a certain number of two-hair grafts were needed, clusters of hair follicles were cut apart into two-hair grafts. This inevitably resulted in some accidental cutting and loss of some hair follicles.



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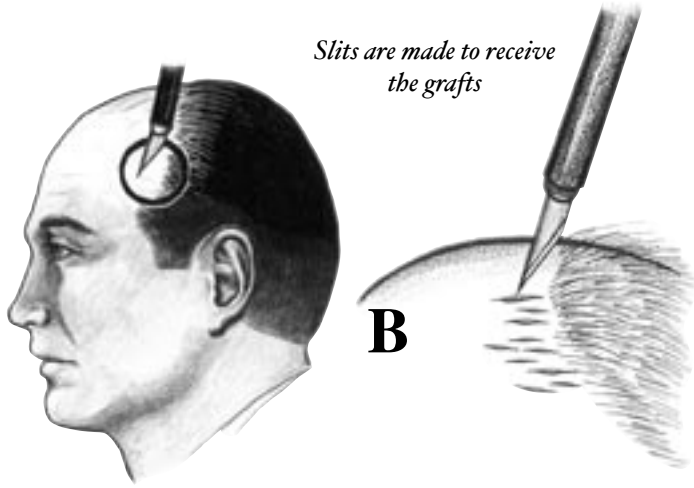
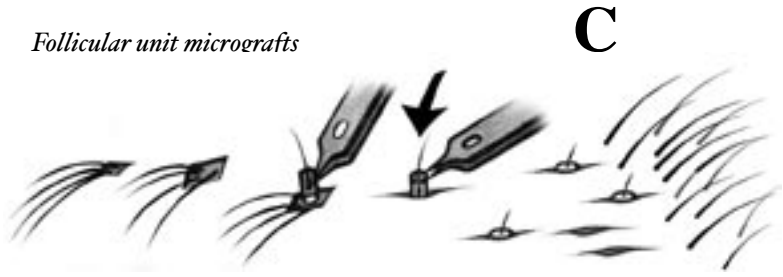
Donor material is cut into follicular unit micrografts

With follicular unit transplant procedures, the medical assistants preparing the grafts use their judgment to identify and cut around follicular units, producing grafts containing one, two, or three hairs according to how many follicular units naturally occur in the donor tissue.

Finally, the follicular unit micrografts are placed into tiny slits made in the scalp with a miniature scalpel. I use a blade designed for eye surgery. The slits are made in a slightly irregular manner, to avoid creating a pattern of rows as the grafts begin to grow new hairs. In the early days of micrografting, surgeons were careful to allow adequate space between each graft, and a variation of a grid pattern was used to make recipient sites. With follicular unit micrografting, adequate space is allowed between grafts; however, the grafts are placed in a more random and natural looking manner.

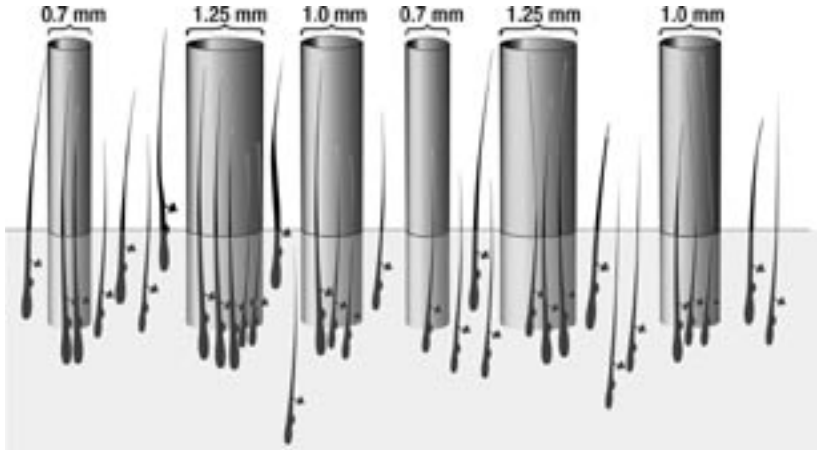




Follicular Unit Extraction (FUE)

This technique of producing follicular unit grafts is possible because of newer, extremely sharp, small sized punches. The technique is similar to the original 4mm full-sized graft technique in that the hair is harvested using a circular punch of 0.75mm to 1.25mm punch (a circular cutting tool similar to a cookie cutter). By using these fine small punches with magnifying loupes, the surgeon can take out intact follicular units ranging from one to three hairs.

When hair transplants were first performed in the 50s and 60s, several studies were conducted to determine the optimum size of a graft using the best punches or trephines of the time. When the grafts were smaller than 3.5 mm in diameter, an increased loss at the periphery of the graft occurred. When the grafts were larger than five mm, loss in the center gave the transplant a donut appearance. Even then we knew the smaller grafts looked better, it was not worth the much higher percentage of hairs lost though transection at the periphery—the smaller the punch, the higher percentage of hairs were lost. Only with the advent of super-sharp small punches has this procedure become more viable, and thus has been more popular and widely used. The FUE method of harvesting grafts is very labor intensive for the surgeon. A much more time consuming process than strip harvesting, it is tiring for both the surgeon and the patient. Not



Folliclar Unit Extration

as many grafts can be done at one session and the much larger donor area has to be trimmed short leading to a longer period before looking cosmetically acceptable.

When the procedure was first introduced in 2002, the results I saw were less than impressive. The amount of scarring in the donor area was not acceptable despite claims the area could heal without visible signs that grafts had been harvested. More importantly, there were limitations as to who could have the procedure. Those with curly hair would be rejected because too many of the hairs would be destroyed by cutting through the curved hair follicle. The "Fox Test" was developed and surgeons began to take sample FUE grafts prior to setting up a final surgical appointment. The Fox Test allowed surgeons to evaluate what percentage of follicles would be destroyed on a patient to patient basis. If the percentage was deemed too high for a particular patient, strip harvesting would be recommended. I had an opportunity to observe several procedures done at the DHI Clinic in Athens in September 2004, and I was quite impressed with the lack of scarring in the donor area and the minimal loss of hairs in the harvesting process. Despite these improvements in the FUE technique, most patients would prefer the strip harvesting method due to the more rapid process of moving the hairs and greater comfort during the process.