

Graft Removal, Redistribution, and Re-implantation Using Follicular Unit Extraction

Background

Hair transplantation has been performed using progressively smaller grafts for over 50 years. Past hair transplant patients often present complaining of visible, unnatural, and unsightly large grafts which have been exposed due to the progression of male pattern hair loss. Vast improvement and naturalization of appearance can be achieved by removing and/or reducing the size of unnaturally large groupings of hair follicles combined with adding follicular units. Various techniques have been used to accomplish this. This case presentation will describe how improvement was accomplished in a patient using follicular unit extraction (FUE) to remove and reduce prior graft size, re-transplant those follicles, and add density by transplanting additional grafts.

This 38 year old white male presented in 2010 complaining of the inability to hide mini-grafts placed in the hairline and frontal half of his scalp in 1996 (fig 1). The patient's result was satisfactory after growth of the grafts but before experiencing additional hair loss in the area. As time passed it became more difficult to hide the large grafts due to progressive male pattern hair loss. Prior to his presentation he concealed the grafts using a combination of three camouflage layers including 1) a dark polish like product applied directly to the scalp 2) a pigmented shake-on protein fiber 3) a top off colored hair spray. The patient complained that it took an hour to apply these layers every the morning. His chief concern and lament was that his eleven year old daughter had never seen him without this camouflage cocktail and he could not go swimming with his daughter due to his fear of her seeing his unnatural appearing scalp. He also noted that his hairline was asymmetrical and lower than desired on the right side (fig. 1).

Preoperative considerations

Due to past transplantation of unnaturally large groups of hair, this patient has a result that appears unnatural and obvious (fig. 1) When punches (often 2mm diameter in 1996) are used to make recipient sites where there remains native hair, damage and loss of existing functional, anagen follicles can result. Therefore recipient sites where hair remained were often made in the past using a #11 or #15 scalpel to minimize damage to existing follicles. Grafts at that time, called minigrafts, contained two to ten follicular units (4-20 hairs). Since the grafts were often larger than the incisions made by a #11 or 15 blade, when grafts were forced into these incisions; compression, elevation, pitting, and misalignment often occurred (figs. 1 and 2). These large grafts look unnatural not only because they are large but also because they were forced into an incision that was too small causing compression and forcing the follicular units closer together than normal. Compression causes the appearance of over density especially juxtaposed to the surrounding scalp that contains little to no hair. Pitting, from forcing the graft too deeply into the incision (often to stop bleeding) or more commonly into incisions made too deeply, further accentuates the unnatural appearance by trapping light in the depressions creating a black hole. Elevation of a graft not placed deeply enough or into shallow incisions, can also disturb the normal scalp surface and its continuity. These improperly placed grafts emphasize the importance of correctly making incision sites with respect to depth, width, and angulation. The length and width of each graft size should be measured and the instrument chosen to make incisions properly calibrated to match graft length and width. Angulation of the incision should mimic the angulation of native hair.

Patients concerns must be acknowledged and addressed. If unrealistic expectations exist, patient education is imperative to set the ground work for a positive result. This patient noted that the right side of his hairline was lower than the left and requested correction, a realistic request. After transplantation, an asymmetrical hair line can exist. It is important to assess hairline symmetry after graft growth and correct it during any subsequent procedures.

Operative considerations

This patient had approximately 500 minigrafts placed into incisions made by a #11 scalpel. Smaller grafts were placed into the hairline which was lower on the right. Grafts were harvested using the strip excision method from the mid-occipital region. The patient underwent excision of a sebaceous cyst superior to the strip excision during an unrelated prior procedure (fig. 3).

The following surgical options for improvement in the recipient area were presented:

1. Complete removal of all grafts by 1-4mm diameter punches, suturing of defects where appropriate (2mm diameter punch or larger) and transplanting additional follicular unit grafts during a subsequent procedure using strip excision or the follicular unit extraction harvesting method (FUE). Removed grafts will be dissected into follicular units and replaced.
2. Surgical excision of hairline with graft removal posterior to hairline and additional grafting as described above.
3. Redistribution of large grafts by removal of targeted follicular units in the hairline and within the large grafts using FUE (1.0-1.25mm diameter punch), re-transplantation of removed follicular units, additional transplantation to the area using strip excision or FUE harvesting method simultaneously or at a later session. No suturing of removed grafts is necessary due to the small punch size.

The patient wanted to achieve large graft reduction and addition of density as quickly and with as little trauma and visible scarring as possible. There are benefits and risks of each option presented. In the recipient area Option 1, complete removal of all grafts using punches would ideally allow for placement of a new hairline and removal of all evidence of unnatural “plugs”. In reality, it would require multiple surgeries as it is difficult and usually impossible to remove all follicles in one surgery. In most patients grafts are close together and if large (2-4mm diameter) punches are made too close together, vascular compromise and necrosis can occur. Islands of intact skin must be left between the punched out skin. If too much skin is removed it would be like Swiss cheese with all holes and no cheese. In this patient’s case since grafts are spaced widely (fig. 4), an attempt could be made to remove all grafts in a single session. Since scar tissue exists around and at the base of the grafts, distortion of the follicles is present causing a higher than normal transection rate from FUE and making the removal of all transplanted follicles impossible. Therefore at least two surgeries are usually required for removal of all follicles with 9-12 months between surgeries to allow for transected follicles to regrow to be visible for removal. To establish additional density with additional grafts at least one additional surgery would be required 6-9 months after the second surgery extending the time to final results to almost three years. Repair patients often present with a hairline that was originally placed too low when the patient was younger. The decision has to be made whether to attempt to naturalize the hairline where it is or to raise the hairline before placement of grafts. With Option 2, surgical excision of the hairline, surgical skill and experience is needed to accomplish a cosmetically acceptable result. This option is used when the hairline is dense and very low, making redistribution with punches of any size impossible. Referral to a surgeon experienced in hairline excision or hairline lifting should be considered. With Option 3, use of FUE to remove small grafts and portions of larger grafts, less trauma is inflicted. When using punches to excise grafts, especially larger punches (greater than 2.0mm diameter) or with surgical excision of the hairline, the addition of scar tissue must be considered. With additional scar tissue the scalp can become discolored or mottled. Also, vascular compromise to some extent can occur. Scar tissue makes grafting mechanically more difficult and along with vascular compromise can potentially reduce the yield from additional grafting. FUE causes the least amount of scarring but also allows for less removal of existing grafts. In grafts with one follicular unit, the entire graft can be removed, while in grafts with multiple follicular units, every other follicular unit can be removed. The decision must be made whether enough cosmetic reduction in graft size can be made by partially reducing the graft content. Using the FUE option, the final result can be seen in 9-12 months after one session. Due to the small size of the FUE punch (0.9-1.25mm diameter), removal, redistribution, and additional grafting can be done in one session of one or more

consecutive days. By accomplishing graft reduction and removal and density addition in one session it was decided that the FUE option was preferable to this patient.

The following options for additional donor harvesting were presented (fig. 3):

1. Strip excision by excising previous strip scar and additional tissue above and below scar to obtain additional follicles.
2. Strip excision by excising a new strip from virgin scalp above sebaceous cyst excision scar.
3. FUE

The patient wanted to have the option to wear his hair as short as possible in the occipital donor area. It was explained that by excising his prior hair transplant scar and additional tissue for more grafts, the scar would be slightly longer and there is a possibility that the resultant scar could be wider than the original and in no way would the scar be narrower. He was also advised that excising in a new area would obviously create an additional linear scar equal or greater in length than original strip scar and of unpredictable width. It is the author's experience that it is impossible to predict the width of any strip excision scar. Ultimate scar width depends not only on the experience of the surgeon but on multiple skin and healing variables/idiosyncrasies of the patient. After the first strip scar is created, subsequent linear strip scars will often be wider whether by scar excision or by making a new scar at a higher or lower location. By using the FUE method, additional small dot scars (1mm diameter or less) are the result but if the patient wears his donor hair long enough to cover the existing strip scar, the small dot scars will ALWAYS be covered. The patients choose option 3, for donor harvesting using FUE.

Surgical Procedure

On day one, the patient's grafts and hair in the prior recipient area were cut short (clipper without a guard) (fig. 4) Although FUE grafting can be done without trimming the recipient hair, it can be accomplished more efficiently and faster the shorter the recipient hair is. When performing graft reduction, re-implantation, and additional FUE grafting, it is imperative that all individual follicular units in all the large grafts be visible therefore the entire recipient should area be clipped as short as possible. Shaving is not necessary. The area was cleaned and then anesthetized with a mixture of lidocaine and bupivacaine using a field block. Graft redistribution was performed using the FUE method. For isolated follicular unit removal, punches of 1.05, 1.10, and 1.25mm diameter on a hand punch were used to accommodate the different sized follicular units. An attempt was made to remove all grafts from the right aspect of the hairline. Hairline symmetry was re-established by removing grafts too low on the right then adding density at a symmetrical line above the previously transplanted hairline on the right and at the level of the transplanted hairline on the left (figs 5, 7, and 15).

A total of 170 follicular units were removed (out of 190 attempts) and re-transplanted posterior to the existing grafts (fig. 5). One hundred and ninety punches were made in the recipient area to remove follicular units, yielding 170 grafts, 20 (10%) resulted in no follicles in the graft due transection of the follicles. When attempting to remove previously transplanted follicles it can be difficult to avoid transection due to scar tissue which can bind and distort the transplanted follicles. A hand punch was used in this case to facilitate determination of the varying angles with which the follicles exited the scalp. When using a hand punch it is easier (than with a mechanical) to incise the skin around the graft at shallow intervals, grasp the head of the graft and pull it to the side to see any change in the hair shaft direction and realign the punch as needed. Recipient sites were made using chisel point scalpels created by the Cutting Edge blade cutter system. For one hair grafts, 0.9mm (cutting length) blade was used, for two hair grafts a 1.0mm blade, and for 3-4 hair grafts a 1.2mm blade was used. Grafts were compared to blade sizes to find the correct size and depth. Five incisions were made and grafts placed to check blade cutting length and depth for appropriateness. Additionally 444 new grafts (1 hair-122, 2 hair-173, 3 hair- 149) were transplanted from the occipital donor area (fig 6) to the anterior aspect of the recipient area using the FUE technique after trimming, cleaning, and anesthesia of the donor area as above. The follicles removed from the originally placed grafts (recycled) were placed posterior to the prior recipient area

(fig. 5). Some surgeons have experienced less than acceptable growth rates of re-transplanted follicles. If the growth rate of those re-transplants in this patient was zero or less than normal, the lack of growth would not affect the area of priority, the hairline and frontal half. Differential graft placement, the placement of the best grafts in the most cosmetically important locations, is an important tool and should be used whenever possible.

On day two, an additional 1114 grafts (1 hair-168, 2 hair-640, 3-4 hair-306) were moved from the occipital donor area using the FUE technique as described above. Grafts were placed into incisions made the same sized blades as on day one. On both days punches of 0.95 and 1.05mm diameter were used to harvest the grafts from the occiput. Since hair shaft diameter and follicular units are larger going from inferior to superior in the occiput, a 0.95mm diameter punch was used inferior to the prior strip scar and a 1.05mm punch used superior to the scar to accommodate existing follicular unit sizes. Also as a result, inferiorly where hair density is less, the FUE scars are smaller and less visible using a smaller punch. A motorized hand piece was used at a speed of 1500 rpm. A total of 1558 grafts from the occiput and 170 from redistributed grafts were transplanted into the recipient area for a total of 1728 grafts (figs. 7 and 8-3days post-op). Incisions 0.9-1.2mm in length can be placed close to the holes resulting from removal of grafts in the recipient area. Judgment must be used and at least a one millimeter small bridge of skin left between the new incision and the punch hole.

Post-operative considerations

There were no complaints or problems during the immediate or extended post op periods. When performing surgery on repair patients, there is a higher incidence of complications due to decreased blood supply from scarring. The occipital strip scar can partially obstruct blood flow superior to the scar. Caution should be exercised before considering a procedure performed superior to one or multiple strip scars especially additional strip scars. Decreased blood flow can lead to delayed healing, infection, and ultimately a wider scar. FUE grafts taken above a prior strip scar generally does not present problems. The author had a patient experience delayed healing and a wider than normal strip scar when an existing strip scar was excised on day one and FUE was performed inferior to the excision on day two.

This patient returned for follow up at five months post op (figs. 9 and 10). Fig. 11 shows the recipient area at 5 months post-op with some camouflage applied. At this time the patient expressed some concern regarding the thin area in the central frontal area where fewer grafts were placed and less growth than he anticipated. He was advised that in order to achieve higher density in the hairline and frontal two centimeters (and due to time constraints) fewer grafts were placed posteriorly. In the future additional grafts can be placed there. It is important to reassure patients that the density at 5 or 6 months does not represent full growth. Especially with repair patients who have undergone prior procedures and who have a relative decreased blood flow, graft growth can take longer (up to 12-18 months) than with virgin scalps. Fig. 12 shows the patient at 7.5 months post-op while fig 13 is taken at ten months post op. You can see the dramatic change over a five month period between five and ten months post-op. Fig. 14 shows the donor area ten months post-op. The patient recently followed up at 2.5 years post op and stated the repair was the best thing he's ever done. He's happy to report that he now goes swimming with his daughter.

Figure legends on next page.

Figure legends:



Figure 1: This pre-operative photo shows the visible, unnatural, and unsightly large grafts resulting from 500 minigrafts placed into incisions made by a #11 scalpel blade. As more hair is lost due to male pattern hair loss, the grafts become more obvious. The angle of the growth from the scalp is unnatural in some grafts deviating laterally.



Figure 2: This photo of the clipped recipient site reveals the minigrafts, many of which are compressed, pitted, and/or elevated. The individual follicular units of the grafts can be seen in a linear orientation corresponding to the shape of the incision made by a #11 blade. Compression of the follicular units within the minigrafts and the resultant over-density is obvious. Grafts which are pitted appear darker and draw additional attention.



Figure 3: The occipital donor area shows an inferior scar from prior strip excision and superior scar from sebaceous cyst excision. The vertical scarring, emanating perpendicularly to the horizontal scar, is created by small tissue tears around the sutures due to the wound edges being pulled tightly. This can be prevented by taking a narrower strip. There appears to be sufficient permanent follicles for an additional strip to be removed superior to the scar although this patient did not want additional linear scarring.



Figure 4: This shows the recipient area clipped, clipper without a guard. This length of the hair is imperative for visualization of individual follicular units alone and within the grafts to be removed. One small area of folliculitis is present (redness). This photo also shows the hairline asymmetry with the right side being lower. The new hairline will be based on the left aspect of this hairline as the lowest extent with the new right side symmetrical with the left.



Figure 5: The smaller grafts in the hairline consisting of one follicular unit and individual follicular units within the minigrafts have been removed with punches from 1.05-1.25mm diameter. Larger punch diameters can be used. Any punch of 2mm diameter or larger is generally sutured. A skin bridge is left between holes except in a few instances. All grafts in the hairline were removed, most were of a single follicular unit. Grafts obtained from follicular unit removal were placed posterior to the cosmetic area of priority in the case that less than optimal growth occurred.



Figure 6: The donor area after Day 1 at which time 444 grafts were removed. A 0.95mm diameter punch was used below the prior strip scar and one of 1.05mm diameter about the scar. A small margin of follicles above and below both scars was not harvested so as not to deprive it of those follicles for concealment of the scar.



Figure 7: This is the recipient area three days post-op. It shows grafts removed below the right hairline and a few below the left hairline to make the hairline symmetrical. One hair grafts are placed in the hairline and anterior one centimeter in an undulating pattern. Two hair grafts are placed about 2-3 centimeter behind the one hair grafts and three hair grafts scattered in the central aspect. A total of 1728 grafts, including the recycled grafts, were placed. Time constraints prevented more grafts from being placed in the central area.



Figure 8: This is the donor area three days post-op. An additional 1114 grafts were removed from the donor area on Day 2 for a total of 1558 grafts removed over two days. You can see with only three days of growth the strip scar is almost concealed. In most cases, within 5-7 days the FUE sites in the donor are healed and covered with the growth of the hair between the punch sites. Additional virgin donor follicles remain laterally for subsequent sessions. It is not recommended that additional follicles be taken above the harvested follicles to leave a buffer to accommodate additional male pattern hair loss.



Figure 9 and 10: These photos show the donor area five months post-op. The strip scar is almost completely covered while the sebaceous cyst scar is visible. There is some thinning from FUE removal in the posterior aspect above the sebaceous cyst scar with the hair at this length. When the patient wears his hair long enough to totally cover both linear scars, all evidence of FUE removal will disappear.



Figure 11: The five month post-op photo of the recipient area shows sparse graft growth. Although much less visible than pre-op, portions of the retained, compressed original minigrafts are visible as are some of the grafts that have regrown in the right hairline. The new hairline is generally now symmetrical. Camouflage has been applied by the patient to conceal the lighter colored skin.



Figure 12: This is the patient 7.5 months post-op. Some camouflage has been applied to the central area. There has been a dramatic increase in volume over a 2.5 month period with a noticeable reduction of minigrafts. While some follicles have regrown in the right hairline below the new hairline, the hairline in general appears more symmetrical.



Figure 13: At ten months post-op the patient's hair has grown to the point that when combed back, the central area of thinning is concealed. This is the preferable length of hair for this patient in the recipient area. Asymmetry is not obvious in the hairline. Any remaining compressed minigrafts are now concealed. Contrast this photo with figure 1.



Figure 14: At ten months post-op with the hair grown longer, all donor scarring is concealed.



Figure 15: This is a 3 day post-op photo of the recipient area showing where the right hairline grafts that were placed too low were removed and new grafts placed. Note there are no visible scars below the right hairline where grafts were removed using FUE.