A New Suture for Hair Transplantation: Poliglecaprone 25

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BACKGROUND. The most common type of donor closure in hair transplantation is with nonabsorbable, running sutures, usually of nylon or polypropylene. This is accomplished with or without buried absorbable sutures. Another popular method of closure is with stainless steel staples. Each of these methods has benefits and limitations with respect to healing, comfort, and convenience for the patient.

OBJECTIVE. The purpose of this study is to describe the use of poliglecaprone 25, a synthetic, absorbable, monofilament suture in hair transplantation surgery, to detail the suturing techniques needed to maximize the benefit of this suture, and to compare this material and suturing technique to a well-established form of closure, that of metal staples in a bilaterally controlled fashion.

METHODS. Poliglecaprone 25 is a synthetic, absorbable monofilament suture of low tissue reactivity. It was compared to closure with metal staples in a bilateral controlled study. One side of the donor area was closed with poliglecaprone 25 sutures using a running cutaneous stitch and the other side was closed with stainless steel staples. Patients were evaluated with regard to healing, postoperative discomfort, resultant surgical scar, and closure material preference.

RESULTS. Of the 22 patients studied, the following postoperative complaints were noted on the staples side: tenderness (12), itching (4), swelling (2), and scabbing (1). This compared to only one complaint of itching and one complaint of swelling on the poliglecaprone 25 side. Two patients had postoperative complaints of visibility of staples showing through their hair. Objective measurements revealed a wider scar overall on the staples side in six patients and wider scar on the suture side in two patients. The average scar width on the staples side measured 1.78 mm compared to 1.42 mm on the suture side. Fourteen of the 22 patients preferred poliglecaprone 25 for future procedures, 1 preferred metal staples, and 7 had no preference. Most patients stated that postoperative discomfort from the staples and the inconvenience and occasional pain associated with their removal was responsible for their decision.

CONCLUSION. Poliglecaprone 25 is a strong synthetic, absorbable, monofilament suture with low tissue reactivity that can be used in hair transplantation to close the donor wound with a single, running cutaneous stitch. This suture can provide a donor closure that ensures hemostasis, has little risk of infection, and is comfortable for the patient. If specific surgical techniques are followed, this suture can provide a donor closure that ensures hemostasis has little risk of complications, is both comfortable and convenient for the patient postoperatively and results in a fine surgical scar.

THE IDEAL SUTURE should be strong, handle easily, and form secure knots. The ideal wound closure should ensure hemostasis, have a low risk of infection, be comfortable for the patient, and result in a fine surgical scar.[1,2] A fine scar in the donor region following a hair transplant is especially important because it gives patients flexibility in styling and the option to wear their hair relatively short. It also allows for efficient harvesting of hair in subsequent procedures, thus maximizing the total donor supply.

The most common type of donor closure in hair transplantation is with nonabsorbable, running sutures, usually of nylon or polypropylene. This is accomplished with or without buried absorbable sutures, usually of polyglactin 910 or polyglycolic acid. This method of closure provides good control of wound edges and is relatively fast, especially when moderate to large bites are used. Larger bites keep the sutures from becoming buried during the healing phase and make their removal easier.

In spite of their popularity, there are several problems associated with this type of closure. The running suture has a tendency to strangulate tissue and compromise the blood supply to the wound edges. This can be problematic when the closure is under tension or when there is a significant amount of edema. The involved tissue will heal more slowly and may be more subject to infection. In addition, the hair follicles incorporated within the sutures may be shed and this hair loss may be permanent. Finally, although synthetic nonabsorbable sutures have low tissue reactivity, they can cause mechanical inflammation if there is any tension on the wound.

To minimize tissue strangulation, a running suture may be used with the bites placed very close to the wound edges. However, the problem with this technique is that as healing progresses, the sutures quickly become buried, making them difficult and traumatic

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to remove. To circumvent the removal issue, absorbable sutures have been used in the cutaneous running stitch. Unfortunately the commonly used absorbable sutures (gut, chromic, polyglactin 910, and polyglycolic acid) all incite a considerable inflammatory reaction in the skin and this inflammation can be associated with permanent alopecia along the suture line.

The purpose of this study is threefold: (1) to describe the use of poliglecaprone 25, a synthetic, absorbable, monofilament suture[3,4] in hair transplantation surgery, (2) to detail the suturing techniques needed to maximize the benefit of this suture, and (3) to compare this material and suturing technique to another type of closure, that of metal staples.

Poliglecaprone 25 has the chemical structure $(C_2H_2O_2)_m(C_6H_{10}O_2)_n$, which forms a complex polymeric chain giving poliglecaprone 25 its special properties. The monofilament is comprised of a soft segment that consists of a random copolymer of ϵ-caprolactone and glycolide that provides good handling characteristics. A hard segment composed of polyglycolide gives the suture its strength.[3] As a result, the suture possesses excellent handling and knot security, minimal resistance as it passes through tissue, and the highest tensile strength as compared to other absorbable monofilament sutures.[3–5]

Poliglecaprone 25 has been shown to be nontoxic, nonallergenic, and without pyrogenic or hemolytic potential.[3] The synthetic material is slowly broken down by the body via hydrolysis and therefore incites little inflammatory reaction in the skin. The reduction in the tensile strength of poliglecaprone 25 as it is absorbed over time is consistent with the requirements of most hair transplant surgery procedures[3,4] (Table 1).

Stainless steel staples were chosen for the comparison because they have the advantage of being totally inert, do not cause tissue strangulation, are fast to apply, and have been reported to result in excellent healing.[6,7]

We performed a bilateral controlled study designed to compare donor wound closure using poliglecaprone 25 sutures with a closure using stainless steel staples. Patients were evaluated with regard to postoperative course, resultant surgical scar, and suture preference. We will also discuss some of our clinical experience with this new suture material.

Table 1. Tensile Strength of Poliglecaprone 25 Postoperatively

Day	*Strength*
7	50–60%
14	20–30%
21	~0%
90–120	Complete readsorbtion

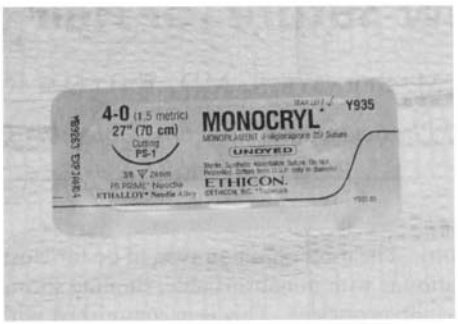

Figure 1. 4-0 poliglecaprone 25 suture.

Methods and Materials

Follicular unit transplantation was performed on 22 adult male volunteers; in sessions ranging from 600 to 2500 grafts using previously published methodology.[8–10] All patients were undergoing their first hair transplant procedure. Donor anesthesia was established with a ring block of 10–15 cc of a solution containing 60% lidocaine 0.5%, 40% bupivicaine 0.25%, and 1:200,000 epinephrine. Donor tumescence was achieved by infiltrating 20–30 cc of lidocaine 0.17% with 1:600,000 epinephrine into the subcutaneous space using 10 cc syringes and 25-gauge needles.

Approximately 2–3 minutes after the tumescent mixture was administered, a donor strip was harvested using two parallel blades set on a Rassman handle 1.2–1.5 cm apart. (The handle preangles the blades at 30° to follow the direction of the emerging hair). In the protocol procedures, the strip widths ranged from 0.9 to 1.3 cm and the lengths from 6 to 25 cm (measurements taken after the strips were harvested). The ends of the donor strip were equidistant from the midline.

One side of each donor area was closed with poliglecaprone 25 suture (PS-1 cutting needle, 70 cm length, undyed) (Figure 1). The contralateral side was closed with stainless steel staples (Figure 2).

On the sutured side, a single running 4-0 poliglecaprone 25 suture was used. The bites were spaced approximately 0.5 cm apart and the suture was advanced on the surface rather than under the skin (as in traditional surgery) in order to minimize the amount of suture in contact with the follicles (see Discussion section). The needle was passed

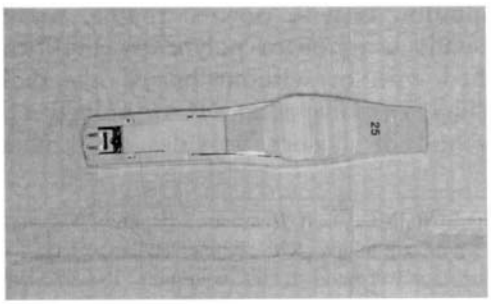

Figure 2. Precise DS-25 stapler.

through the full thickness of the dermis and exited the wound edge just below it (at the level of the bulbs) without incorporating any significant amount of subcutaneous tissue. The needle track was kept parallel to and within 1.5 mm of the wound edge (Figure 3A, B).

Since the upper wound edge is cut at a 30° angle, the needle must penetrate the skin with an "upward" motion (with the patient in a sitting position) so that the needle remains parallel to the wound edge through its entire course through the tissue. Occasionally the upper wound edge will be distorted by the elastic retraction of the dermis so that the upper wound edge may require slight eversion with rat-tooth forceps for proper suture placement. This is usually not required for the lower edge, where needle placement is easier.

The wound edges on the stapled side were approximated with a skin hook grasping the lower edge and rat-tooth forceps grasping, and slightly everting, the upper edge (this required the help of an assistant). Once the wound edges were flush, the staples were applied in such a fashion that the middle of the staples rested slightly above the incision line. This permits a better grasp of the upper wound edge whose edge is thinner due to the acute angle of the blades. The staples were placed approximately 0.6 cm apart (Figure 4).

Patients were evaluated for postoperative complications, discomfort, and resultant surgical scar. Recorded observations were made on follow-up visits 10–14 days (Figure 5) and 6–8 months postoperatively. Staples were removed at the 10- to 14-day postoperative visit. The sutures were left

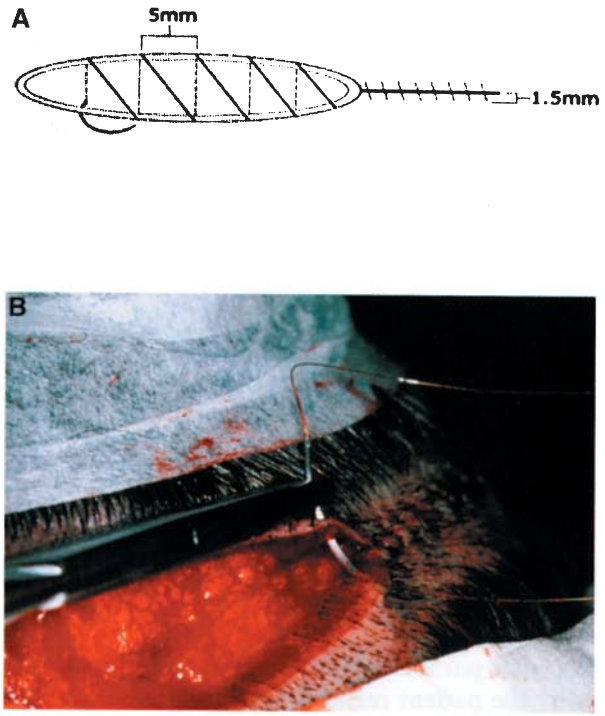

Figure 3. A) Schematic of the suturing technique with surface advancement of each loop spaced approximately 5 mm apart. B) Suturing technique shows a simple running stitch. Note the needle penetration very close (≤1.5 mm) and parallel to the wound edge.

Figure 4. Stapling technique shows very controlled approximation of the wound edges using skin hooks to raise the lower edge and forceps to evert the upper edge of the wound.

in place. Postoperative complications and discomfort were assessed via questionnaires filled out by the patients at the time of their follow-up visits. The surgical scar was evaluated subjectively with questions on donor area cosmesis and objectively by measuring the width of the donor scar at multiple points along the suture line. Finally, all patients were asked the question, "Which suture would you prefer in future procedures?"

Results

The results of the 22 patients in our study are summarized in Table 2. The following postoperative complaints were reported on the staples side: tenderness (12 patients), itching (4 patients), swelling at the suture line (2 patients), and scabbing (1 patient). This compared to two postoperative complaints for the poliglecaprone 25 side: itching (one patient) and swelling (one patient).

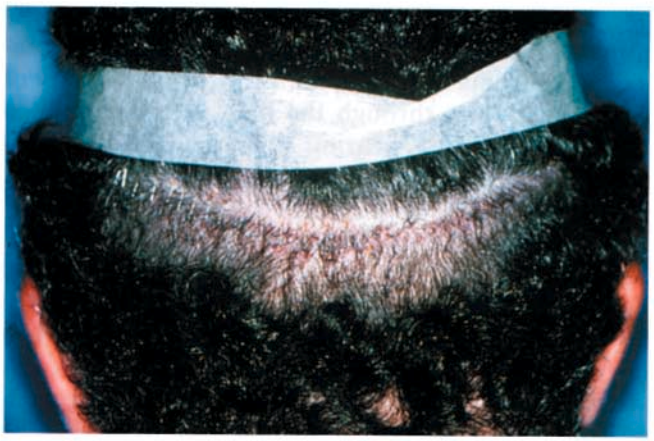

Figure 5. Appearance of a typical closure at 12-days postoperatively.

Table 2. Summary of Data from the 22 Patients Enrolled in the Study

	Poliglecaprone 25	*Staples*	*None or no difference*
Postoperative complaints			
Tenderness	0	12	10
Itching	1	4	17
Swelling	1	2	19
Scabbing	0	1	21
Postoperative complications			
Bleeding	1	1	20
Infection	0	0	22
Dehiscence	0	0	22
Donor area cosmesis			
Visibility	0	2	20
Can't wear short	0	0	22
Hair loss	0	0	22
Scar width (mm)			
Cases wider	2	6	14
Minimum	0.98	1.14	—
Maximum	1.46	2.15	—
Average	1.42	1.78	—
Suture preference	14	1	7

Of the 22 patients studied, 1 patient reported postoperative bleeding on the staples side and one noted it on the sutures side. Further questioning, however, revealed that these patients had only experienced some blood on the postoperative dressing. There was never any active bleeding noted by any patient in the study, any that required intervention on the part of the patient, nor any that prompted a call to the physician. There was no infection or wound dehiscence on either side.

Since it was difficult for patients to directly assess their donor scar, we used an indirect method that we labeled "donor area cosmesis." This had three components: visibility of the suture material in the immediate postoperative period (0–2 weeks), the inability of the patient to wear his hair as short as he had been accustomed to in the more extended postoperative period (4–8 months), and any perceived hair loss along the suture line. Only two patients had postoperative complaints regarding cosmesis, both related to visibility of the actual staples through the hair. No patients had any problems with wearing their hair short in the more extended postoperative period and none had any perceived hair loss from either type of closure.

Donor scars were measured in multiple points to assess the widest, narrowest, and average widths. Measurements revealed a wider scar overall on the staples side in six patients and wider scar on the suture side in two patients (Figure 6). The average scar width on the staples side measured 1.78 mm compared to 1.42 mm on the sutures side. (Refer to Table 2 for the average minimum and maximum scar widths for each type of closure.)

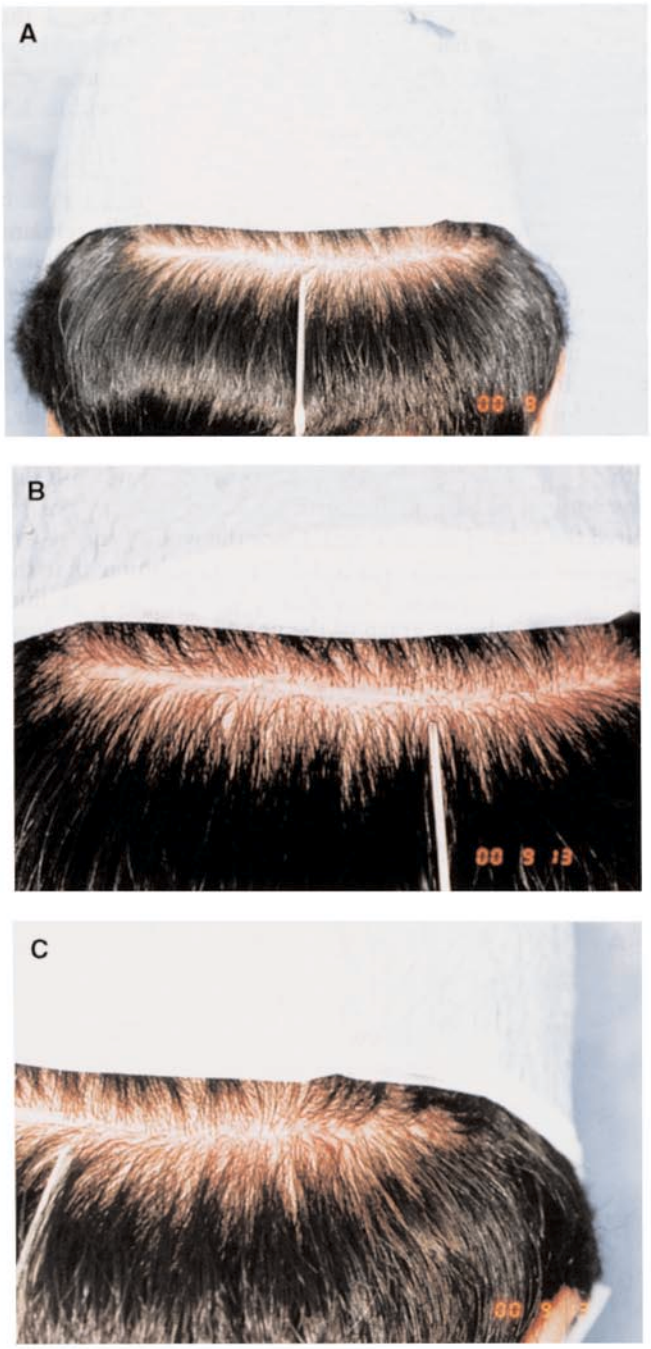

Figure 6. A) Midline view of a patient with a wider scar on the staples side (left), as compared to the sutures side (right). Photo taken 14-months postoperatively. B) Detail of the left side (staples) showing a scar that is wider and more geometric in appearance. C) Detail of the right side (sutures) showing a fine, ill-defined scar.

The final parameter was a subjective global assessment by the patient regarding suture preference. In response to the question "Which suture would you prefer in future procedures?," 14 of the 22 patients preferred poliglecaprone 25, 1 preferred metal staples, and 7 had no preference. The reason behind their

choice was explored in more detail in the comments section of the questionnaire. Most patients stated that postoperative discomfort from the staples and the inconvenience and occasional pain associated with their removal was responsible for their decision. It is important to note that in the comments section, five patients qualified their answer by stating that, in spite of their preference, they would choose the side that gave the best results when undergoing future procedures.

Discussion

The ideal wound closure should ensure hemostasis, have a low risk of infection, be comfortable for the patient postoperative, and result in a fine surgical scar. A fine scar in the donor region following a hair transplant is especially important because it gives the patient flexibility in styling and the option to wear the hair relatively short. It also allows for efficient harvesting of hair in subsequent procedures, thus maximizing the total donor supply.

Since March 1998 we have been closing the donor site of the majority of our hair transplant patients with a single running cutaneous suture using poliglecaprone 25. The suture, a synthetic, absorbable, monofilament with low tissue reactivity, appears to have some distinct advantages over other types of materials. We reported our preliminary results with this suture at Seventh Annual Meeting of the International Society of Hair Restoration Surgery, San Francisco, CA, in October 1999.

Poliglecaprone 25 sutures are made from a copolymer of glycolide and caprolactone. This synthetic material is broken down by the body via hydrolysis and therefore doesn't incite the typical inflammatory reaction characteristic of other absorbable sutures. Because of this, the suture can be used to oppose tissue at the level of the hair follicles without the risk of significant damage to these structures. In addition, the translucent sutures are skin colored and are barely visible once the donor area is sutured closed.

In our experience, carefully harvesting the donor strip by superficial dissection in the midfat layer, followed by meticulous approximation of wound edges under little tension, and placing sutures very close to the wound edges will maximize the chance of a fine scar. A superficial incision that spares fascia will allow for a superficial closure and healing without the dermis being bound to the deeper tissues. This will help preserve scalp laxity for subsequent procedures and possibly minimize postoperative edema by causing less interference with lymphatic drainage.

Placement of sutures within 1.5 mm of the free edge will provide for excellent dermal-to-dermal contact and perfect wound edge apposition without the incorporation of unnecessary tissue and associated hair follicles. This allows the blood supply to reach the edges of the wounds unimpeded and also prevents any postoperative edema that might place tension on the sutures and strangulate the tissue. This is especially important in large hair transplant sessions, which can be associated with significant amounts of postoperative edema that can compress hair follicles entrapped in the running sutures and cause permanent alopecia (Table 3).

When a running stitch is used in traditional skin surgery, the surgeon advances the suture as it travels through the subcutaneous tissue so that, on the surface of the skin, the visible parts of each loop appear perfectly parallel. Under the skin, however, each suture takes a diagonal course. The reason for this is twofold. The first is to have a more organized, "neater" appearance and the second is to minimize any suture marks on the skin surface. In scalp surgery, the goal is just the opposite. When operating in a hair-bearing area, the object is to minimize the amount of suture in contact with the follicles to prevent hair loss. Therefore the sutures should run parallel in the fat (so that they don't cross over and entrap follicles) and should be advanced on the surface, where any transient suture marks on the skin are irrelevant.

When using small bites very close to the wound edge, sutures tend to get buried within several days after the surgery and become problematic to remove at 1–2 weeks. Poliglecaprone 25 offers a distinct advantage over nonabsorbable sutures because they don't need to be removed.

A more subtle advantage of placing sutures close to the wound edge is that it allows for a greater surface area that can be stretched to close the wound. When large bites are used the elasticity of the skin between the sutures actually pulls the edges away from each other, making approximation more difficult and the wound tension greater.

Recently Kolasinski[11] described using a running intradermal poliglecaprone 25 suture to close the donor area. This technique has the benefit of avoiding tissue strangulation, but has the disadvantage of a less secure apposition of the wound edges. In addition, it is a more laborious technique. Our limited experience with

Table 3. Guidelines for Using Poliglecaprone 25 Sutures

Plan width of donor strip so that there is little or no tension on closure.
Use tumescent anesthesia to harvest donor strip in midfat.
Use sutures no heavier than 4-0 or 5-0 gauge.
Use a simple running stitch, advancing each loop on the skin surface.
Keep needle parallel to and within 1.5 mm of wound edge.
Incorporate epidermis and dermis only.
Use 0.5 cm spacing between loops.

this suturing method suggests that it may have an advantage over a simple running stitch in very short incisions with no tension, but is inferior for the majority of closures in our practice. Bilateral comparisons need to be made to determine the ideal indications for each technique.

Another advantage of poliglecaprone 25 suture is the in vivo duration of its tensile strength. Its initial strength is comparable to that of the very strong, nonabsorbable suture polypropylene. At 7 days it maintains 50–60% of its tensile strength and at 14 days (the longest time that nonabsorbable sutures are generally left in place) it still has 20–30% of its strength. In situations when there is no undue tension, this permits the wound to be closed without the need for buried sutures. This has the advantage of a shorter operating time and eliminates the possibility that subcutaneous sutures can impinge upon and damage hair follicles.

Because of the excellent tensile strength of poliglecaprone 25 sutures, we were able to close all of our wounds with 4-0. In nonstudy patients with short incisions under no tension, we have occasionally used 5-0 with excellent results. The important point is that using heavier poliglecaprone 25 sutures (ie, 2-0 or 3-0) is unnecessary and will result in more inflammation, poorer wound healing, and complaints of slow absorption by the patient. As with taking large bites, using a suture heavier than 4-0 will negate many of the benefits of using poliglecaprone 25 and is strongly discouraged by these authors.

In this study, metal staples were chosen for the comparison because they are totally inert, do not cause strangulation of the wound edge, are fast to apply, and have been reported to result in excellent healing.[6,7] However, our study has shown that they have the disadvantage of being uncomfortable for patients in the postoperative period. In addition, they require a follow-up visit for their removal (which also can be very uncomfortable), and most importantly, result in a wider scar than sutures in most patients when there is even minimal wound tension. In addition, we found that although fast to apply, staples did require some degree of skill to apply properly and requires an assistant to hold the wound edges perfectly flush as the staples are applied.

Staples did not appear to hold the wound edges as securely as sutures, so that there was slightly more postoperative oozing (this was observed in our practice, but not in the study). In addition, in some patients neck flexion caused the edges to shift slightly, resulting in a slightly perceptible ridge along the suture line (this was never observed with sutures). Finally, staples produced a very distinct linear scar and, even when it was very fine, did not blend in as well with the surrounding hair as did the scar resulting from poliglecaprone 25 sutures.

Staples produced a measurably finer scar in two patients in the study. Both of these patients had high density and very loose scalps. This is consistent with the general experience using staples in our practice. It appears that staples offer a slight, but definite, advantage in these select patients. In our practice, we presently offer the choice of staples to patients who fall into this category of high density and good scalp laxity and who, in addition, are undergoing a relatively small procedure (requiring a donor incision of 14 cm or less). The best explanation for the generally superior healing with poliglecaprone 25 sutures over metal staples is the ability to consistently achieve perfect wound edge approximation when sutures are meticulously placed.

The experience in our facilities, where more than 2000 patients have had closures using poliglecaprone 25 sutures, has been that poliglecaprone 25 has a slightly greater incidence of pruritus than the less than 5% reported in this study. We find that the true incidence is probably on the order of 10–20%. The small *n* value of this study would likely account for this difference. Postoperative pruritus can be greatly reduced by keeping the suture line occluded with a thin layer of ointment of any kind (we routinely use bacitracin ointment) for 2–3 weeks following surgery. It is important to note that in the current study, excluding tenderness, there was little difference in side-effects between the two sides.

A complaint from some patients in our practice that was not reported by any patients in the study was persistence of the knots at the ends of the running poliglecaprone 25 suture. All patients are told preoperatively that although the sutures will have lost their strength by 3 weeks postoperatively, the knots may persist longer. When the knot persists longer than 3 weeks it is usually because some hair was incorporated into the knot during the suturing. Since the knot is not subject to hydrolysis by the body, it will sit on the surface of the scalp until it loosens from the hair. The most likely explanation for the difference in the rate of complaints between our general patients and those in the study is the greater attentiveness to preoperative discussions by patients enrolled in the study and thus the greater awareness that this might occur. After 2 weeks any patient complaining of a persistent knot is advised to either return to the office for removal or instructed to simply cut the knot off with fine scissors at home.

In summary, poliglecaprone 25 is a very strong synthetic, absorbable, monofilament suture with low tissue reactivity that can be used in hair transplantation to close the donor wound with a single running cutaneous stitch. If specific surgical techniques are fol-

lowed, suturing with poliglecaprone 25 can produce a fine surgical scar superior to metal staples and can result in a more comfortable postoperative experience for the patient.

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Commentary

Doctors Bernstein, Rassman, and Rashid have clearly and concisely presented a case for the use of Poliglecaprone 25 as the primary suture material for closure of donor sites after hair transplantation. They compare closure using Poliglecaprone 25 versus staples and show that patients prefer this type of suture material because of the low incidence of reactivity and irritation. The authors also present useful suggestions on how to place the sutures to yield the best wound apposition and cosmetic results. However, the clear advantage of using this type of suture material in preference to other closure materials is less clear objectively. The traditional suture materials used, such as Prolene, Vicryl, Dexon, and staples all yield comparable cosmetic results when placed appropriately. While there may not be a significant advantage to using Poliglecaprone 25 in terms of final cosmetic appearance compared to other closure materials, the ease of use and the increased post-operative comfort to the patient are distinct advantages. I have been using Poliglecaprone 25 for years in my dermatologic surgery practice and no longer use any other absorbable suture materials. I would encourage dermatologists and dermatologic surgeons to try this versatile suture material for any and all surgical procedures.

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