

# Hand Rejuvenation with Structural Fat Grafting

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A simple, reliable technique of autologous fat grafting for long-lasting rejuvenation of the dorsum of the hand is presented. With this technique, small intact parcels of fatty tissue are harvested with a syringe and a blunt 3-mm cannula. Then, most of the nonviable components are removed from the harvested subcutaneous material by centrifugation, decanting, and wicking. Finally, a 17-gauge blunt cannula places the fat in minuscule parcels of tissue with many passes through five or six tiny incisions in the hand. Separation of the tiny parcels of fat maximizes contact between the surfaces of the transplanted fat and surrounding recipient tissues to encourage integration, anchoring, and long-term survival. Structured, purposeful placement of a thin layer of transplanted fat rejuvenates the dorsal hand by restoring a slight fullness to atrophic subcutaneous tissue, by softening the color and definition of exposed extensor tendons and dorsal hand veins, and by supporting the aging skin. (*Plast. Reconstr. Surg.* 110: 1731, 2002.)

Hands are the most visible unclothed area of the human body other than the head and neck. Although we have sophisticated techniques for erasing the signs of aging from human faces, physicians have been largely unsuccessful at rejuvenation of the hands. In the late 1980s, autologous fat grafts demonstrated promise as a means of rejuvenation by restoring a youthful fullness to the dorsum of the hand.<sup>1-3</sup> However, almost all descriptions of fat grafting to the hand have warned of unpredictable results. From 1989 to 1992, I used a technique of placing fat as a lump into the dorsum of the hand and digitally manipulating the lump into a thin layer. After the edema subsided, I noticed a high rate of irregularities and inconsistent long-term survival similar to that reported by others. After I tried a major change in my instrumentation and placement technique in 1992, I have seen dependable results, longevity, and almost no complications.

### *Alternative Therapies*

Lasers and chemical peels improve the dorsum of the aging hand by exfoliating, improving elasticity, and removing lentigines. Unfortunately, such treatments to the hand have not demonstrated the same predictability as in the face, presumably because of the paucity of appendages and the highly mobile and thin skin of the dorsal hand. With such topical hand therapies, hypertrophic scarring and changes in pigmentation are possible<sup>4</sup> and the results are often temporary.<sup>5</sup> In any case, these treatments do nothing to restore a youthful fullness to the dorsal hand, except for the temporary edema associated with inflammation. As the fullness associated with inflammation dissipates, the aged appearance of the dorsal hand returns.

Excision of an ellipse of dorsal hand skin has been proposed for rejuvenation of the hand.<sup>6</sup> Even if this surgical procedure does not limit mobility of the wrist or leave a visible scar, tightening of the skin in the aging hand will accentuate the veins and tendons and can make the dorsal hand look older, albeit with fewer wrinkles. Youthful skin is not just tight but also has subcutaneous fullness.

Despite the plethora of dermal and subdermal fillers currently available throughout the world (commercially and surgically), none have reported success at restoring fullness to the dorsum of the aging hand.

### FAT GRAFTING

Fat has been surgically transplanted since the nineteenth century, and the history of autologous fat grafting is well described in our literature.<sup>7-9</sup> Fournier was one of the earliest to

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describe fat grafting into the hands.<sup>1</sup> He championed a technique of injecting fat in a lump through one incision in the back of the hand. With digital manipulation, the solitary lump of fat was then spread over the entire dorsum of the hand and sometimes up into the fingers. Although numerous methods for harvesting and refining fat have been put forth, every description of fat grafting to the hand<sup>2,3,10,11</sup> has been with a placement technique similar to that of Fournier's, as described above. All of these authors reported variable and discouraging long-term results. Moreover, even in the few descriptions that show results of longer than 2 months,<sup>12,13</sup> it is difficult to discern an improvement between the before and after photographs.

Although I reported my success with fat grafting in the face as early as 1988,<sup>14</sup> I did not graft fat to the dorsum of the hand until 1989. My harvesting and refinement technique in 1989 was similar to the current technique. However, the first method I used to place fat into the dorsum of the hand was radically different from the method that I used in the face and from the method that I use now for placing fat into the hand. The method used for fat placed in the face was to layer the fat in many passes; whereas in the hand, the entire amount of fat to be placed was squirted in only a few passes. From 1989 to 1992, I used a 16-gauge sharp needle to inject fat in several lumps, and then I tried to disperse the fatty tissue evenly over the dorsum of the hands. After the swelling had dissipated at 4 months postoperatively, there appeared to be little difference as compared with the preoperative appearance. In contrast, during the same period from 1987 to 1992, I noted relatively consistent survival of fat infiltrated into the face.<sup>15,16</sup> The fat seemed to survive in the face and disappear in the dorsum of the hand.

In 1992, to minimize damage to nerves and blood vessels, I abandoned sharp needles and switched to blunt cannulas for placement of all fatty tissue. With blunt cannulas, I did not have to be as concerned about perforation of the dorsal hand veins. I began using a technique similar to the one I had used in the face, weaving fat with many passes into the subcutaneous layer of the hand. Using a blunt cannula to purposefully place minuscule amounts of fatty tissue with each pass produced dramatically superior results and consistent longevity in the dorsal hand. I use the expression "structural fat

grafting" to distinguish this structured, purposeful method of grafting fat<sup>17,18</sup> from the previously described methods of squirting fat in amorphous lumps and then attempting to manipulate it.

#### THE AGING HAND

The dorsum of an attractive, healthy-appearing hand has a slight subcutaneous fullness that obscures veins and tendons but does not hide them. The tendons are more defined on extension of the metacarpophalangeal joints or of the wrist than on flexion or repose. The superficial veins are usually discernible, and the more slender and athletic an individual, the larger and more distinct these veins appear. The blue color of the veins can be seen through the skin, but the white tendon color is not usually discernible. The generalized fullness of the skin and subcutaneous tissues adds volume to the nonbony hand and frames the joints with a youthful fullness.

In the aging dorsal hand, generalized subcutaneous fullness gradually disappears as the subcutaneous tissues atrophy.<sup>19</sup> As the fullness covering them dissipates, the veins become prominent and their blue color deepens. The white color and anatomic details of the extensor tendons become more visible through the thin skin of the dorsal hand. The tendons become obvious even at rest or flexion of the metacarpophalangeal joints. With the loss of the supporting fullness from under the dermis and gradual loss of elasticity, the skin assumes a texture similar to crepe paper and wrinkling becomes more prevalent. The intermetacarpal spaces deepen, especially between the thumb and the index finger; and intermetacarpal wasting can be further complicated by loss of intrinsic muscle volume with aging or disease. Generalized loss of fullness of the hand and fingers can also make the joints appear enlarged and arthritic.

Many physicians claim that loss of fat with aging is a justification for placing fat into the dorsum of the aging hand.<sup>12,20</sup> However, the attractive young hand is not fat, and the dorsum of the normal human hand is not an important repository of fat. The technique of structural fat grafting described here aims to create an integrated layer of fat grafts over the dorsal hand that looks and feels like thicker skin and has a slight subcutaneous fullness. The objective of this technique is not to make

a fatter hand; it is to restore a youthful fullness to the back of the hand.

#### PATIENT SELECTION

The best candidates for rejuvenation of the hand with fat grafts are patients with noticeable loss of subcutaneous fullness of the dorsal hand and apparent thinning of the skin. This is usually accompanied by exposure of the underlying veins and tendons along with an increase in the crepey appearance of the skin. Patients with intermetacarpal wasting or arthritis are also candidates because adjustment of the volume proportions of the hand will create a much healthier appearance.

#### TECHNIQUE

##### *Harvesting*

The abdomen and medial thighs are most often used for harvesting because they are easily accessible with the patient in the supine position. Sterile technique should be followed at all times during the procedure.

Local, regional, epidural, or general anesthesia is used depending on the patient's preference and anesthetic risk. Through an incision made with a no. 11 blade, I infiltrate a solution into the donor sites using a blunt Lamis infiltrator (Byron Medical Inc., Tucson, Ariz.) attached to a 10-cc syringe. For local anesthesia, I use 0.5% lidocaine with 1:200,000 of epinephrine. During epidural and general anesthesia, a solution of 1:400,000 of epinephrine in Ringer lactate helps to maintain hemostasis. The solutions are infiltrated in a ratio of roughly 1 cc of solution per cubic centimeter of fat to be harvested.

The fat is harvested through the same incisions previously made for infiltration of anesthetic solutions. The harvesting cannula is 3 mm in diameter and 15 or 23 cm in length with a blunt tip (Fig. 1). The two distal openings positioned extremely close to the end give the tip a shape reminiscent of a bucket handle (Fig. 1, *above, left, inset*). Around the distal openings, sharp edges are minimized to encourage harvesting small parcels rather than long strips of tissue. The harvesting cannula is connected to a 10-cc Luer-Lok syringe. Parcels that are able to pass through the lumen of a Luer-Lok aperture (Fig. 1, *below, right, inset*) will usually pass through the much smaller 17-gauge lumen of the infiltration cannulas without clogging.



FIG. 1. Harvesting cannulas have blunt tips in the shape of a bucket handle (*above, left, inset*). The proximal end is shaped to fit securely into a 10-cc Luer-Lok syringe (*below, right, inset*).

Gently pulling back on the plunger of a 10-cc syringe (Fig. 2) provides a light negative pressure while the cannula is advanced and retracted through the harvest site. Devices that lock the plunger of syringes into place and high-pressure vacuum suction systems used for liposuction can create higher negative pressures, and they may damage the fragile fatty tissue during harvesting. A surgeon can more easily manipulate a syringe that is 10 ml or smaller to maintain a minimal negative pressure during harvesting.

After filling the syringe with harvested subcutaneous tissue, the cannula is removed from the syringe. A “dual function Luer-Lok plug” is twisted onto the syringe (Fig. 3, *left*) to seal the Luer-Lok aperture and prevent spillage during the centrifuge process. Do not use the plugs that accompany the syringe, because they frequently leak.

##### *Refinement*

After sealing the Luer-Lok end, the plunger is removed from the barrel of the syringe and

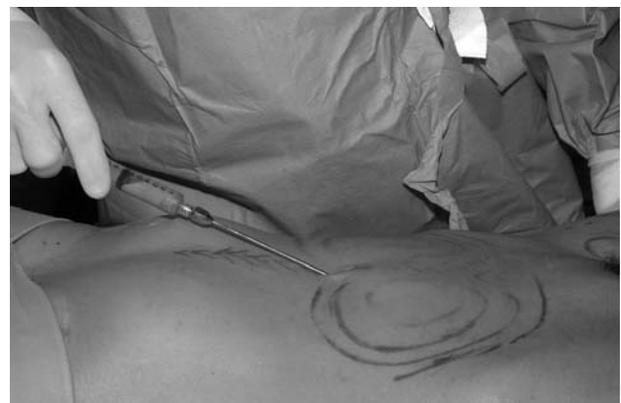


FIG. 2. Pulling back on the plunger of a syringe creates a slight negative pressure while the harvesting cannula connected to a 10-cc syringe is pushed and pulled through the subcutaneous tissues.



FIG. 3. After collecting subcutaneous tissue into the syringe, the harvesting cannula is removed and a dual-function Luer-Lok plug for capping is twisted onto the end (*left*). The plunger is then removed from the syringe, and the body of the syringe is placed into a centrifuge (*right*) and spun at about 3000 rpm.

the body of the filled syringe is placed into a centrifuge (Fig. 3, *right*). A centrifuge with a central rotor and sleeves that can be steam-sterilized is recommended because it reduces the chance of contamination. Centrifuging at about 3000 rpm for 3 minutes separates the harvested material into three layers (Fig. 4, *left*). The upper level, or less dense level, is composed primarily of oil from ruptured fat cells. The middle portion is composed predominantly of parcels of tissue. The lowest level is the densest layer and is composed primarily of blood, water, and lidocaine.

The oil layer should be decanted (Fig. 4, *above, center*) before removing the plug from the syringe. Next, the plug is removed and gravity drains the aqueous portion out of the syringe (Fig. 4, *below, center*). Cottonoid surgical strips (Codman and Shurtleff, Raynham,



FIG. 4. Centrifuged material separates into levels based on density (*left*). The oil is decanted (*above, center*). The Luer-Lok cap is then removed and the aqueous components are allowed to drain (*below, center*). A Cottonoid surgical strip is inserted into the barrel of the syringe touching the harvested fat for at least 4 minutes to wick off any remaining oil (*right*).

Mass.)<sup>21</sup> are placed into the open end of the syringe against the harvested fat (Fig. 4, *right*) to wick any remaining oil. The surgical strips are left in place for at least 4 minutes and are changed twice. Any fat that does not fall off when a surgical strip is being removed is discarded because scraping fat off of the surgical strip will damage the fragile fat parcels. Fat desiccates easily, and histologic studies have demonstrated cytoplasmic lysis of up to 50 percent of the cells exposed to air for 15 minutes.<sup>12</sup> A brief exposure to ambient air is inevitable during these stages of harvesting and refinement, but exposure to air should be minimized.

### Transfer

To transfer the refined fatty tissue directly from the 10-cc syringe into the 1-cc syringes, first the plunger is placed back into the barrel of the 10-cc syringe. Then the end of the 10-cc syringe is placed into the open barrel of an empty 1-cc Luer-Lok syringe in which the plunger has been removed (Fig. 5, *above*). A column of the refined fat is advanced into the 1-cc syringe while the 1-cc syringe is held in an upward oblique direction. Filling a syringe in an upward direction minimizes the introduction of air bubbles. The column of fat is allowed to slip back to the mouth of the barrel in the 1-cc syringe and the plunger is replaced (Fig. 5, *below*). The fat is ready for infiltration.

### Structural Fat Placement

General anesthesia or regional blocks are used for anesthesia of the hands. To avoid perforation of veins, the only sharp instruments used are 27-gauge needles to place local anesthesia at the incision sites, 25-gauge needles for regional blocks, and no. 11 blades to make the incisions. Incisions 1 to 2 mm in length are placed in the direction of the wrinkle lines on the hands at six or seven sites spaced around the periphery of the hand. The most common locations for incisions are at the ulnar and radial wrist, at the level of the metacarpophalangeal joints at the ulnar little finger (Fig. 6, *below, left*), the web space between the ring and middle finger (Fig. 6, *center*), the radial index finger, and the radial thumb (Fig. 6, *above, left*).

The instruments used for placement of fatty tissue are dramatically different from the harvesting cannulas. The blunt infiltration cannula is completely capped on the tip with a lip

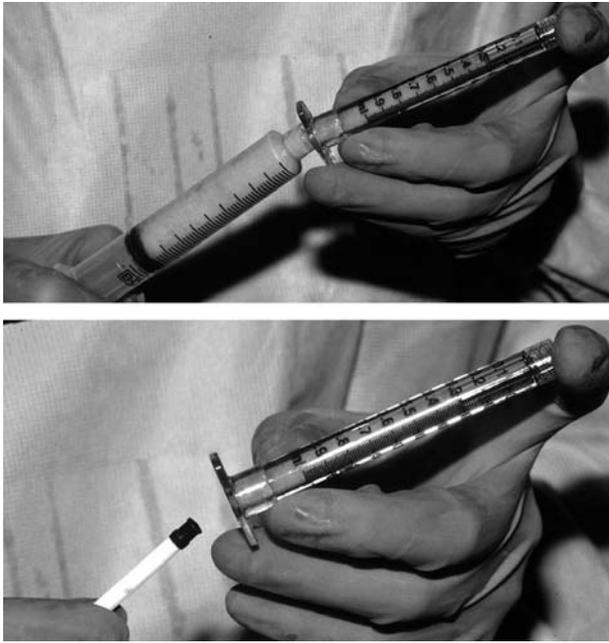


FIG. 5. Refined fat is transferred into 1-cc Luer-Lok syringes. The 1-cc syringes should be filled in an oblique upward direction to avoid air bubbles (*above*). Placing the index finger over the Luer-Lok controls the column of fat as it slips down the syringe (*below*). The plunger is then replaced and advanced to remove the dead space.

that extends 180 degrees over a solitary distal aperture (Fig. 7). For placement into the hand, I use cannulas 7 or 9 cm in length with a 17-gauge lumen.

An infiltration cannula connected to a 1-cc Luer-Lok syringe is inserted into the incision and advanced through the tissues. While grasping the barrel of the 1-cc syringe (Fig. 6, *center*), a slight pressure on the plunger with the surgeon's finger or thumb is made only during the withdrawal of the cannula to express a minuscule amount of tissue. With each pass of the cannula, the maximum increment of tissue that I routinely place into the hand is less than 0.1 cc and can be as small as 0.02 cc. The small, 1-cc syringe gives much greater control over the increments of placement with each pass. Accuracy of the initial placement is imperative because the shape is difficult to mold significantly without creating irregularities. Therefore, as the tissue is incrementally placed, the projected plane of fat is created with each pass of the cannula by placing minuscule amounts of tissue in close proximity to one another but separated from one another by a tiny space. If the surgeon accidentally allows a cyst or clump to form, immediate digital manipulation can usually flatten such minor irregularities so that

the newly placed fat has no lumps and feels evenly placed.

The level of placement for rejuvenation of the hand is primarily in the immediate subdermal plane superficial to the veins to support the skin. A large number of passes are made through each incision site to develop a radiating pattern. Placement of fat from multiple directions creates a "weaving" pattern of placement (Fig. 6). The fat placed by this weaving method supports the skin.

I usually begin from the radial metacarpophalangeal thumb incision with placement into the proximal phalanx of the thumb and radiate a pattern through the first web space (Fig. 6, *above, left*) over the thumb metacarpal (Fig. 6, *above, right*) almost to the palmar aspect of the radial hand. I use more than 100 passes in a radiating fashion to place 3 to 4 cc of fat. I then insert a cannula through the incision in the radial index finger at the level of the metacarpophalangeal joint. From here, I place fat through the first web space into the subcutaneous plane of the proximal phalanx of the thumb radiating over the metacarpals of the thumb, index finger, and middle finger to eventually place fat into the proximal phalanges of the middle and index fingers. After that, I use the incision between the middle and ring metacarpophalangeal joints to radiate a pattern of placement from the proximal index and middle fingers over the back of the hand (Fig. 6, *center*) to the proximal ring and little fingers. Next I use an incision through the skin of the ulnar hand at the level of the metacarpophalangeal joint of the little finger to place fat into the proximal fingers (Fig. 6, *below, left*), radiating a pattern gradually (Fig. 6, *below, right*) almost to the ulnar aspect of the palm. Finally, through incisions at the ulnar and radial wrist, I place radiating tunnels of fat from the distal forearm to the palm of the hand.

The extent of the area of grafting is adjusted to the physical appearance and desires of the patient. To avoid the appearance of enlarged joints, little if any fat is usually placed over the metacarpophalangeal or proximal interphalangeal joints. To cover the superficial digital veins and place fullness evenly around the metacarpophalangeal joint, fat should usually be feathered to at least slightly past the proximal half of the proximal phalanx. However, some patients may opt for a less extensive or more extensive placement, because placing even a minuscule volume of fat over the fingers

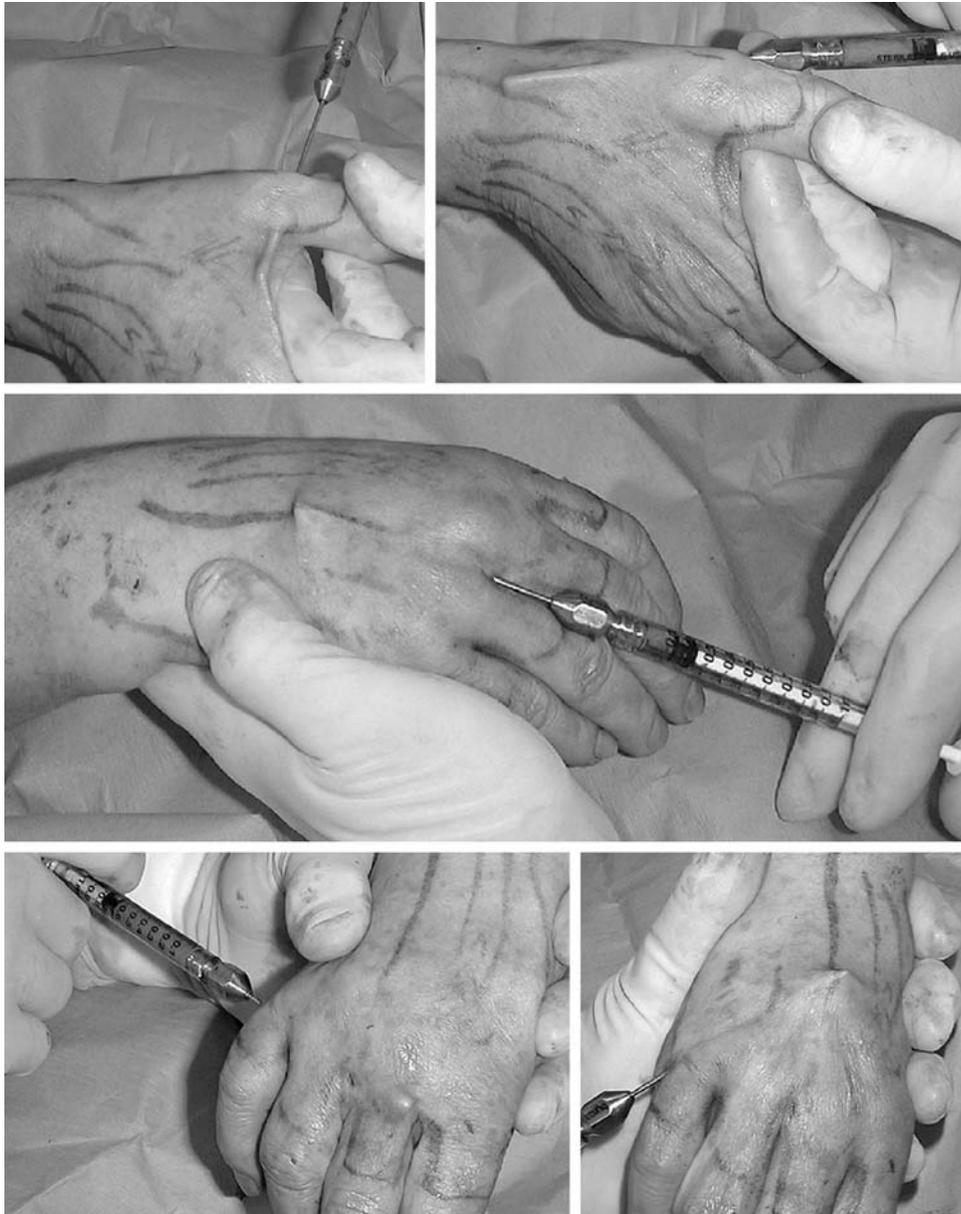


FIG. 6. From an incision in the radial thumb at the level of the metacarpophalangeal joint, numerous passes are made to place minuscule tunnels of fat into the proximal phalanx of the thumb and the first web space (*above, left*). From the same incision, fat is gradually placed over the dorsum of the hand in a radiating pattern almost to the palm (*above, right*). After a radiating network of tunnels has been placed from the radial incision, a similar network of tunnels is made from two different web space incisions (*center*). Fat is infiltrated into the proximal phalanges from the distal ulnar incision (*below, left*). The direction of the passes made by the infiltration cannula is gradually changed from distal to proximal during the many passes (*below, right*).

may change a patient's ring size. Also, patients with thicker fingers may not be appropriate candidates for placement of more volume onto the fingers. Usually, fat is placed to cover the wrist, and even onto the distal forearm if the veins are bothersome in that area, but this can vary with each patient's desires and physical

appearance. Incisions are closed with simple interrupted 6-0 nylon sutures.

#### *Postoperative Care*

Edema is the most consistent postoperative sequela associated with this technique. In the first hours and days after placement of fat, the

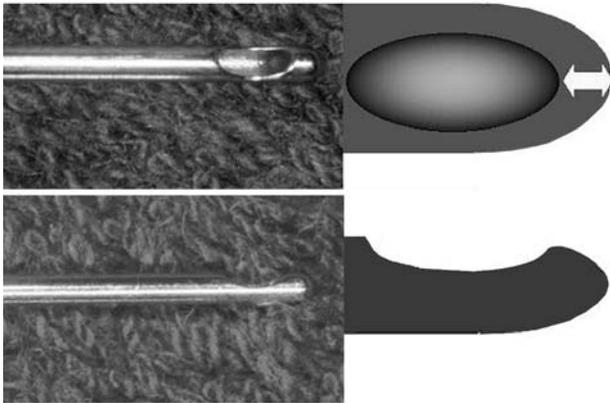


FIG. 7. A front and side view of the tip of the blunt 17-gauge cannula used for placement of the fatty tissue. The 7- to 9-cm cannula is completely capped with a side opening located within 2 mm of the blunt tip.

emphasis of postoperative care is to protect the dorsum of the hand and to minimize the formation of edema. A protective barrier of Microfoam tape (3M, St. Paul, Minn.) is placed on the skin of the infiltrated areas immediately after the procedure and is left in place for 3 or 4 days. This limits the patient's ability to touch the dorsal hand, because pressing on the infiltrated areas during the first few days may move the newly placed fatty tissue through the dorsal hand's loose areolar planes. Although patients may use the palmar surfaces of their hands immediately, I recommend that they not touch the back of the hand for at least 1 week. Particular attention should be paid during sleep, and patients are cautioned not to sleep with their heads against their hands. The tight layer of Microfoam tape on the skin of the infiltrated areas will also create a slight compression over the grafted areas that may reduce edema. Obviously, patients are also instructed to keep their hands elevated above the level of the heart and to use cold compresses as tolerated.

#### CASE STUDIES

##### Case 1

A 55-year-old woman was concerned that her hands looked much older than her face. She was most bothered by the increasing visibility of her tendons and veins but also complained of wrinkling. Her tendons had become easily defined, and the white color glistened through the thin skin of her hand. Her veins, although not large, had become obvious (Fig. 8, *above, left*; Figs. 9 and 10, *left*). Fat was harvested under epidural anesthesia in the following quantities: 40 cc from the abdomen, 30 cc from each medial thigh, and 15 cc from each medial knee. This 130 cc total was refined down to 60 cc, which was divided equally between the two hands. The refined fat was placed over the dorsum of the hand from the middle half of the proximal phalanx to the distal one-third

of the forearm and from the ulnar palm to the radial palm. The patient returned at 12 days (Fig. 8, *above, right*) and at 2 months (Fig. 8, *below, left*) for photographs. She next returned at 5 years (Fig. 8, *below, right*) with no intervening topical or surgical therapies to her hand. On physical examination, the patient retained a subtle fullness over the proximal fingers, dorsum of the hand, and distal forearm. Dorsal hand veins were barely visible and the tendons were visible but less defined (Figs. 9 and 10, *right*). The patient was pleased that the one treatment had disguised her veins and tendons but kept an "elegant definition" to her hands.

##### Case 2

A 53-year-old woman presented with tortuous, large, visible veins and white tendons clearly visible through paper-thin skin (Fig. 11, *left*). From the abdomen, 90 cc of fat was harvested and refined to 40 cc of usable tissue, which was divided evenly between the two hands. Because the patient did not want to change her ring sizes, she asked not to have any fullness added to her fingers. Therefore, fat was placed only from the wrist up to the metacarpophalangeal joints, and no fat was placed over the proximal phalanx. When she returned at 3 years and 2 months, the skin appeared to be much thicker and had a youthful-appearing subcutaneous fullness (Fig. 11, *right*). Her tendons were still visible but not as defined, and their white color was not discernible. Likewise, the color of the dorsal veins had changed from a deep blue to a light blue and they were not as obviously protuberant or conspicuous. The digital veins were still obvious in the areas where fat had not been placed around the metacarpophalangeal joints and the fingers. The patient was extremely pleased.

##### Case 3

A 52-year-old woman presented bothered by the "bony look" of her hands with enlarged joints and prominent tendons and veins. She had a history of arthritis that may have contributed to the enlarged joints. She also had significant intermetacarpal wasting (Fig. 12, *left*). From her inner thigh and abdomen, 170 cc of fat was harvested under local anesthesia and refined to 52.5 cc of usable fat. From the proximal phalanx to just proximal to the wrist, 25.5 cc was grafted into her right hand and 26 cc in the left hand. Extra volume was placed into the intermetacarpal spaces, especially between the thumb and index finger, to diminish the wasted appearance of the hand. The patient returned at 1 year with an extremely healthy-appearing hand. The joints had lost their enlarged, arthritic appearance because of the volumes placed into the web spaces, intermetacarpal spaces, and fingers. There was a significant decrease in wrinkles over her entire hands. She reported that she thought her hands were "fabulous and smooth" (Fig. 12, *right*).

##### Case 4

A 62-year-old woman presented with crepey hand skin and increasingly noticeable veins and tendons (Fig. 13, *left*). She specifically wanted to place fat onto the middle phalanx to decrease the boniness of her proximal interphalangeal joints and the metacarpophalangeal joints. At the same time as a facial procedure, 29 cc of refined fat was placed into the left hand and 28 cc into the right from the distal forearm over the proximal phalanges and onto the middle phalanges almost to the distal interphalangeal joint. The patient returned at 39 months (Fig. 13, *right*) and was enthusiastic about her results.

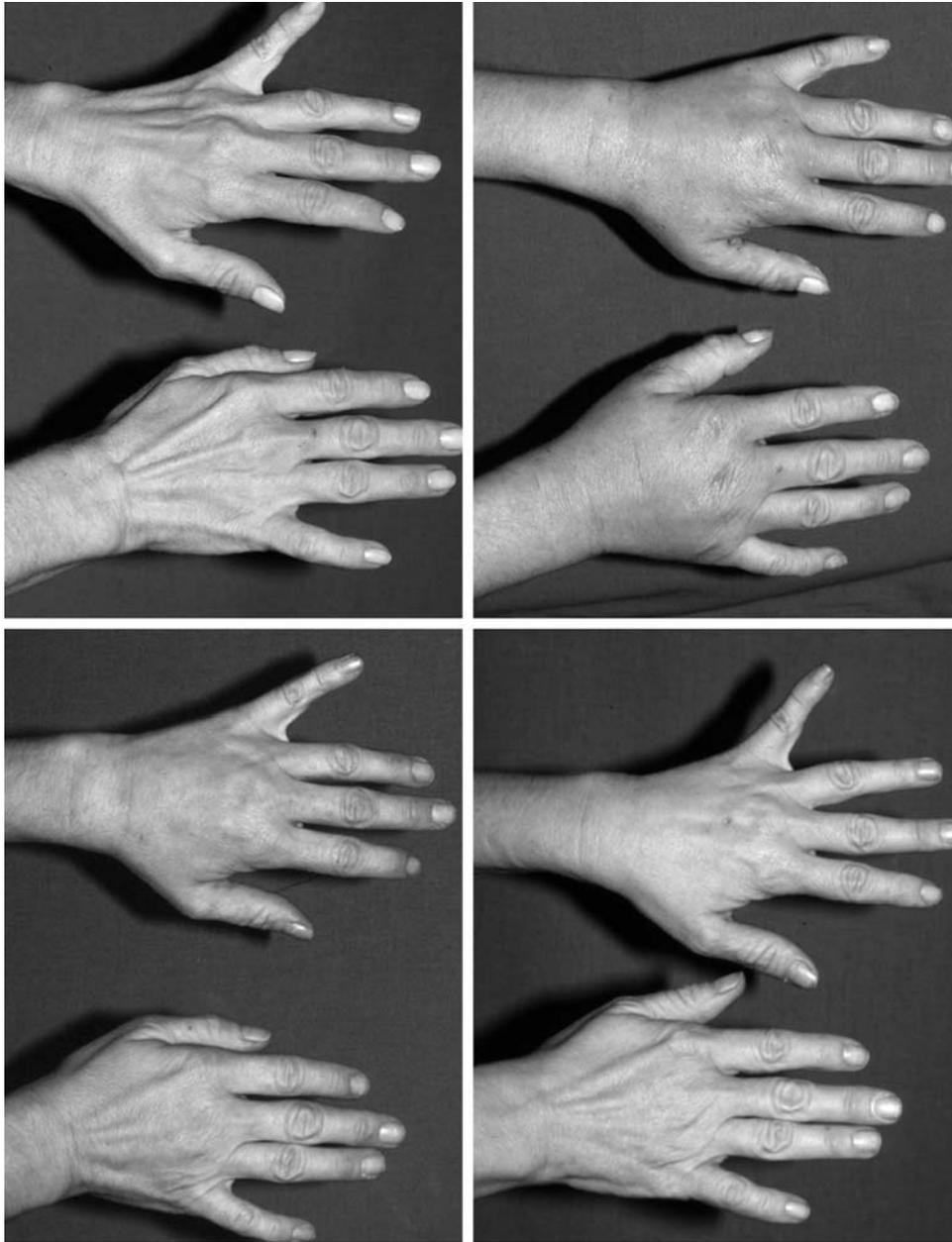


FIG. 8. Case 1. A 55-year-old woman before (*above, left*), 12 days after (*above, right*), 2 months after (*below, left*), and 5 years after (*below, right*) 30 cc of fat was placed in each dorsal hand from the proximal phalanx to the distal third of the wrist. There was only minimal change between the photographs at 2 months (*below, left*) and 5 years (*below, right*). All photographs were taken with the hands extended to the patient's side at heart level.

#### Case 5

A 40-year-old woman presented preoccupied by early signs of aging in her hands. The small but prominent veins around her metacarpophalangeal joints and early definition of her extensor tendons particularly bothered her (Fig. 14, *left*). From the proximal phalanx stopping at the wrist, 23 cc of fat was placed into the left hand and 25 cc into the right. The patient returned 1 year later saying she wanted just a little more fat placed, especially over the wrist area. One year after the first procedure, 5.8 cc of refined fat was placed in the left hand and 5.7 cc in the right hand. Sixteen months after the

second procedure (Fig. 14, *right*), the small veins in her hands were barely visible and the tendons were softened. The patient thought that her hand looked much younger and more attractive.

#### Case 6

A 59-year-old man presented with prominent extensor tendons glistening through the skin of his hands and thin-appearing sun-damaged skin (Fig. 15, *left*). He was concerned about losing too much definition of his veins because he thought they looked athletic. At the same time as a facial



FIG. 9. Case 1. A close-up of the right hand with the fingers in slight flexion (*left*). Five years after 30 cc of fat was grafted, the tendons and veins are less apparent but still visible (*right*).

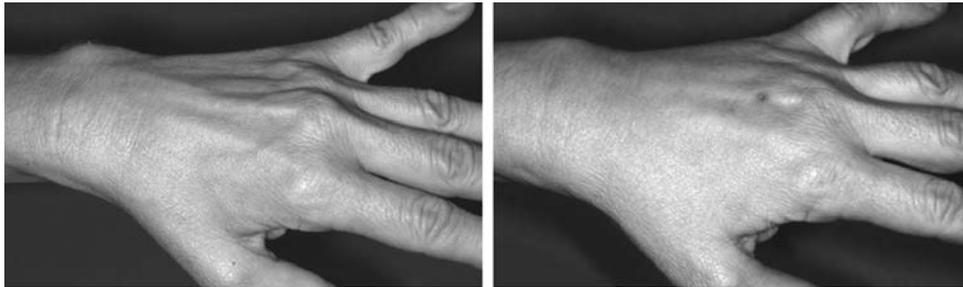


FIG. 10. Case 1. The left hand with the fingers in extension before (*left*) and 5 years after 30 cc of fat was grafted (*right*).



FIG. 11. Case 2. A 53-year-old woman before (*left*) and 38 months after (*right*) 20 cc of fat was placed into her dorsal hand from the metacarpophalangeal joint to her wrist. The digital veins are relatively unchanged because fat was not feathered up into the fingers.

procedure, 32.5 cc of fat was placed into each hand from the proximal phalanx, feathering well up onto the forearm. The patient returned at 1 year (Fig. 15, *right*), with his tendons less visible through the dorsum of his hand and an improvement in the overall texture of his hands. His veins were still athletic appearing even though the veins were not as starkly distinct.

#### Case 7

A 56-year-old woman complained that the conspicuous tendons and tortuous veins on the back of her hand gave away her age (Fig. 16, *left*). Concurrent with a facial procedure, 23 cc of refined fat was placed into the right hand and 21 cc into the left hand. The patient returned at 25 months (Fig. 16, *right*), delighted with the results.

#### RESULTS

From 1992 until 2000, I performed primary fat grafting for rejuvenation of the dorsal hand and

forearm in 22 patients. The only complication that occurred in this series was scarring of the dorsal skin of one hand during a concurrent chemical peel. The age of the patients at the time of the procedure ranged from 36 to 83 years, and two were male. Excluding the fat atrophy from catabolic steroid injection mentioned in the subsequent Complications section, I have added more fat at a later date to only three hands in two patients. One patient (Fig. 14) was pleased with the appearance of her hands but wanted more fullness over both wrists. Another patient wanted a small amount of additional fat placed into her left hand even though she had good initial correction (Fig. 16). I placed 5 cc more into her left hand, after which she was pleased.

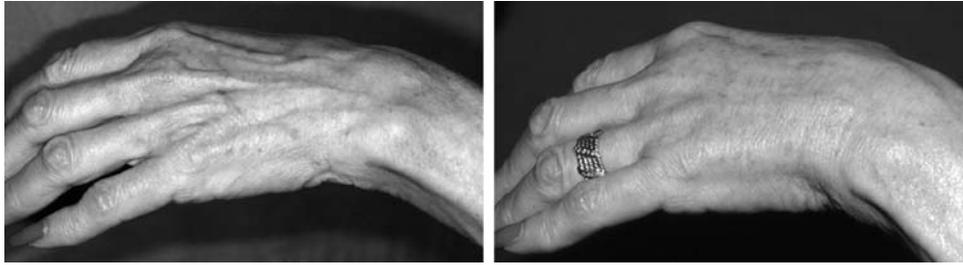


FIG. 12. Case 3. A 52-year-old woman with arthritis and intermetacarpal wasting (*left*). One year after 26 cc of fat was layered into her hands (*right*). Fat was feathered over the proximal phalanx and into the web spaces to disguise the size of her arthritic metacarpophalangeal joints. More volume was placed into the intermetacarpal depressions to correct the wasted appearance and give her hand a healthier appearance.



FIG. 13. Case 4. A 62-year-old woman who had 29 cc of refined fat placed into the left hand and 28 cc in the right (*left*). The patient had fat feathered proximal to her wrist and past the proximal interphalangeal joint onto her middle phalanx. At 39 months (*right*), the patient returned with a generalized youthful subcutaneous fullness of her hands and less boniness of her joints.



FIG. 14. Case 5. A 40-year-old woman before (*left*) and 16 months after (*right*) the second of two fat grafting procedures. In first procedure, 25 cc of fat was placed in the hand, and 5.8 cc was placed in the second procedure.

In this series, I grafted for rejuvenation of 47 hands in 22 patients. All patients have returned pleased with the softening of the color and definition of the veins and tendons. The slight radial force can tighten the overlying skin so that some smoothing of wrinkles may occur; however, wrinkling of the dorsal hand, especially during mo-

tion of the wrist or fingers, will still occur. All patients recognized improvement in the texture of their hands and could clearly see a change in the photographs, but a few were disappointed that wrinkling remained, especially on extension of the wrist and fingers. The photographs shown (Figs. 8 through 16) are

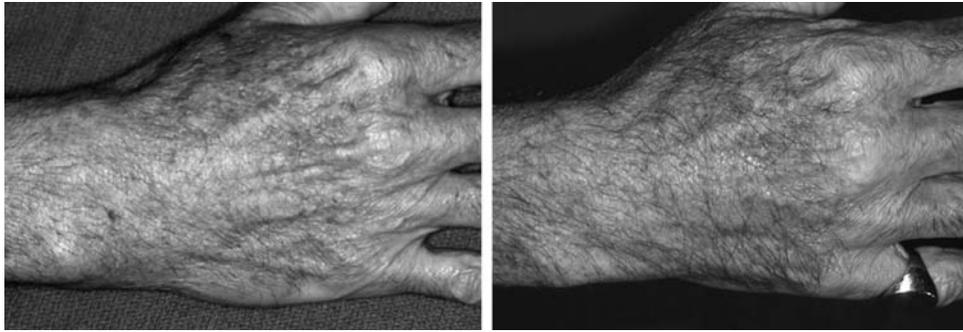


FIG. 15. Case 6. A 59-year-old man with well-defined extensor tendons (*left*). One year after 32.5 cc of fat was grafted into the hand, the tendons are less defined with a slight subcutaneous fullness (*right*).

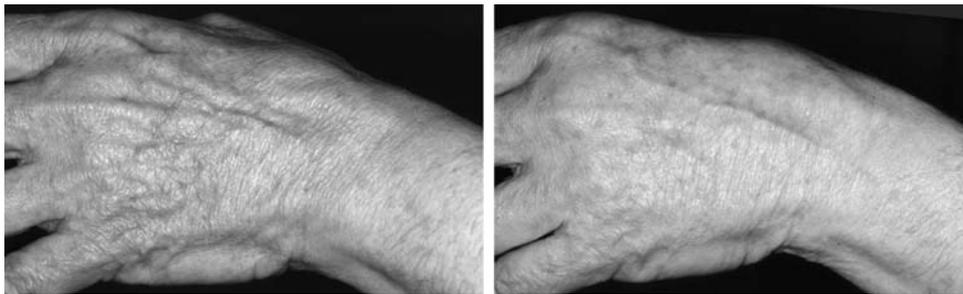


FIG. 16. Case 7. A 56-year-old woman before (*left*) and 25 months after (*right*) 23 cc of fat was placed into the dorsal hand.

representative of the consistent results obtained using the structural fat grafting technique with the volumes mentioned.

#### *Photography*

Comparison of before-and-after photographs is the key to evaluation of results in hand rejuvenation. Photography of hands and forearms for assessment of the long-term results requires special considerations because the hand can assume different appearances with changes in angles and positions. I always have the patient hold the hand that I am photographing at the level of their heart and out to the side. This keeps the hands at a neutral level to avoid venous engorgement (by lowering the hands below the heart) or venous evacuation (by elevating the hands). I photograph the hands from both the right and left sides and at various angles, from flat to oblique and lateral. I also photograph the hands relaxed and in different degrees of extension.

Photography is a crucial aid to the physician for estimating future volumes of infiltration. Over the past 12 years of grafting fat to the dorsal hand, I correlate the appearance of the dorsal hand to the amount of fat grafted when

the patient returns for follow-up. This helps me to estimate future volumes objectively based on my previous experience.

#### *Placement Volumes*

There are many considerations in estimating the volumes of fat to be grafted. Obviously, some of the material placed is not viable fat. A portion of the fat tissue will die because mechanical trauma damages the delicate fatty tissue during even the most careful harvesting, refinement, and placement. Varying quantities of blood, lidocaine, or oil will be present in the fatty tissue even after the refining. The edema caused by forcing a blunt cannula through living tissue can immediately obscure the visual clues that might be used for determining an endpoint. This swelling varies considerably from patient to patient or even hand to hand in the same patient. Because all of these visual clues seen during infiltration of fat can be deceptive, the intraoperative appearance of the hand should not be used to determine the amount of fat to be placed. Therefore, I estimate the volume to be infiltrated before beginning the procedure.

It is my experience that 10 cc of fat placed in the dorsum of the hand will make almost no

improvement in the appearance of the hand. Placing 12 or 15 cc of fat into the dorsal hand will make a slight improvement, but I recommend placing at least 20 cc in each hand for most patients. If the patient desires significant feathering onto the forearm or correction of intermetacarpal wasting, more fat will be necessary. I do not try to overcorrect; that is, I do not place fat with the idea that it will significantly reabsorb. I place the amount of tissue that I think will attain a certain result based on my previous experience. A frequent question asked about fat grafting is, "How much of the grafted fat will survive?" I do not know. I know that 10 cc of fat has one result in the dorsum of the hand, 20 cc has another, and 30 cc has still another. My concern is to have the grafted fat survive evenly and predictably.

#### *Edema and Longevity*

Bruising is not a significant sequela with this technique because veins are not easily perforated by a blunt placement cannula. Nevertheless, hundreds of passes with a cannula will create substantial swelling in the dorsum of the hand. Hands are usually natural appearing and presentable, if somewhat puffy, within 2 or 3 weeks after the procedure; however, observant patients may notice changes in the amount of swelling for 16 to 20 weeks or more.

The prolonged swelling associated with this procedure can confuse not only patients but also physicians. If the result is judged to be final when significant swelling remains (at 4 weeks for instance), then the patient and the physician may assume that fat is reabsorbing when simply not enough fat was placed. Although a good estimate of the amount of fat placed can be determined at 16 weeks after the procedure, a more accurate estimate of the amount of fat placed without confusing edema should be made after 6 or 8 months. After that time, little change will usually be seen in the fullness of the dorsal hand. In this series of cases reported, fatty tissue harvested, refined, and placed under the skin of the dorsal hand in the specific manner described here has demonstrated consistent longevity.

#### *Complications*

Before 1992, I used sharp 16-gauge needles to inject lumps of fat into the dorsum of the hand and then massaged the fat into a smooth layer. In those patients, I experienced unpredictable results and two complications. I had

some small but noticeable lumps perhaps caused by uneven spreading of fat or migration. None of the irregularities bothered the patients enough to have them removed. Irregularities and migration have not been a problem with fat placed into the dorsum of the hand since 1992, when I changed the placement technique.

The only other complication in the hand was unilateral scarring of the dorsal hand during a simultaneous chemical peel. In 1992, immediately after grafting fat, I performed an Obagi peel<sup>22</sup> at a 30–3 level (diluted 30% trichloroacetic acid) to the dorsum of both hands immediately after grafting fat. The patient experienced unilateral scarring on the dorsum of the hand. Injection of 0.5 cc of 20 mg/cc of triamcinolone into the scars 8 weeks after surgery further complicated the hand's appearance by causing atrophy of the grafted fat. Later, grafting fat into the patient's hand using blunt cannulas and a weaving technique yielded good results. Although physicians continue to advocate combined therapies with fat grafting,<sup>2,23</sup> I have not combined any topical therapy with fat injections since then.

Of course, with any surgical procedure, infection and damage to underlying structures are always potential complications. I have seen no bacterial or viral infections in patients with fat grafts to the upper extremity. I have also not seen a significant hematoma in the dorsum of the hand after the use of blunt cannulas, and patients have not complained of changes in sensation. Fat grafting to the dorsum of the hand has an extremely high satisfaction rate, a relatively fast recovery, and few complications compared with most aesthetic surgical procedures.

#### DISCUSSION

##### *Harvesting and Refinement*

With this structural fat grafting technique, fat is harvested as an intact tissue parcel that is already small enough to pass through a small lumen cannula. This eliminates the need to later reduce the size of the parcel of fat by straining, chopping, washing, and other methods. Such actions can disrupt the fragile architecture of fatty tissue. For instance, "washing" of the harvested tissue<sup>13</sup> subjects the connective tissue and reticular fibers to trauma and may disrupt the fragile fatty tissue architecture.<sup>24</sup> It is also possible that washing fat will remove

fibrin so that it does not anchor to the surrounding tissues as well.<sup>25</sup> However, intact parcels of fatty tissue harvested in the manner described here appear to be able to withstand brief centrifugation to yield long-term results. Using the tumescent technique for harvesting would subject fatty tissue to damage that is similar to washing.

To predict the volume of fat to be placed, it is important that the material infiltrated is primarily viable fatty tissue. Freshly harvested subcutaneous material in a syringe can contain as little as 10 percent and as much as 90 percent of potentially viable fat. Obviously, placement of a 10 percent concentration of fat will give a dramatically different result than will placement of a 90 percent concentration. For that reason, as much of the oil, blood, water, and extracellular components should be removed as is possible without causing significant damage to the tissues to be transplanted.

#### *Placement*

All other descriptions of fat grafting into the hand describe squirting lumps of fat into the hand and trying to mold the lumps into a smooth layer. Even though injected fat can be manipulated to move somewhat through the subcutaneous planes of the hand dorsum, there are several problems with manipulating a lump of fat to create a smooth, thin layer. The biggest problem is control. To mold a lump of tissue into a uniform layer is simply difficult. Flattening a lump from the fingers to the wrist and from palm to palm is even more complicated.

Next, pushing fat around the dorsum of the hand is traumatic. Not only is there a potential for damaging the fragile fat, but also edema invariably occurs in the subcutaneous tissues during manipulation. With remarkable edema present over the hand dorsum, it becomes difficult to detect lakes or clumps of fat during the molding process. As the swelling dissipates over the following few weeks, irregularities become apparent.

The key to fatty tissue placement is to maximize the surface area of contact between the harvested fat and the recipient tissues to encourage nutrition, respiration, stability, integration, and uniformity of the grafted fat. Each cell in the transplanted fatty tissue must have access to nutrition to live. Studies have demonstrated that as little as 40 percent of grafted fatty tissue is viable 1 mm from the edge of the graft at 60 days.<sup>26</sup> In other words, 60 percent of the grafted fat cells

that are more than 1 mm from a source of nutrition and respiration will die. In a parcel isolated from other grafted parcels, decreasing the diameter of the grafted fatty tissue parcels makes the most central cells closer to the outside of the parcel and to a blood supply. Because the surface area that is in contact with the surrounding host tissues becomes relatively large for the volume inside of the small parcel, the chance of the entire parcel receiving enough nutrition and oxygen is much greater in such small parcels than in large parcels. For that reason, placing relatively small parcels of fat is important for eventual survival.

However, if even the small parcels of fat are injected into the hand in a lump, most of the outside surfaces of the parcels of fat will be touching one another rather than the host tissues. The adjacent fat parcels will block one another's access to capillaries, and the surface area of the parcels that is in contact with the host tissues will be reduced. The more that the parcels come into contact with one another, the farther most of the cells become from the host tissues. A group of four parcels in a lump can more than double the distance to the host tissue capillaries of a large portion of the cells.

Separating the parcels of fat by placing them in many passes allows the parcels to touch more of the surrounding host tissue and thereby maximizes the surface area of contact of fatty tissue with the surrounding host tissues. This creates a larger surface area not only for diffusion respiration but also for anchoring of the fat. A greater surface area allows host tissue fibrin<sup>25</sup> to act as an adhesive to bind more surfaces to one another. Increasing the contact of the grafted fat cells with the surrounding tissue increases anchoring and stability of the grafted fat.

Grafted fat left even in small clumps will usually feel and look like lumps of fat if it manages to survive. By placing fat into small parcels and separating every parcel possible with the donor-site tissues, the transplanted fat does not feel like fatty tissue. Instead, it feels like the tissues into or next to which it is placed. Fat placed in a structural manner will assume the general textural quality of thicker skin with subcutaneous fullness. That is, fat parcels placed next to skin will feel on palpation like thicker skin, not like fat under skin. The structural fat grafting technique emphasizes placing fat in minuscule quantities with each withdrawal of the blunt cannula to encour-

age stability, integration, uniformity, and longevity of the placed fat.

#### CONCLUSIONS

Placing fat in a structured fashion with many minuscule tunnels of parcels of fat over the dorsal hand creates underlying support and a radial expansion of the skin. The physical presence of a thin layer of tissue will not only decrease the blue of the dorsal hand veins and the white of the extensor tendons, but it will also obscure or soften the shape of veins and tendons. The overall effect is to create an apparent thickening of the aging skin of the dorsal hand with an underlying youthful-appearing subcutaneous fullness. The purposeful placement of fatty tissue to form a structured layer can restore a long-lasting, youthful fullness to the dorsum of the hand.

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