

# CHAPTER 47 ■ STRUCTURAL FAT GRAFTING

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With the recent recognition of the importance of soft-tissue fillers, fat grafting has assumed an increasingly important roll as both an adjunctive and a primary procedure in aesthetic and reconstructive surgery. However, fat grafting is not new. Surgeons have been grafting fat since 1893 (1). In 1926, Charles Conrad Miller described his experiences with infiltration of fatty tissue through cannulas (2). He believed depositing fat through a hollow metal cannula resulted in a better long-term correction and a more natural-appearing change in facial and body contours than fat grafting through an open incision. Even though Conrad Miller reported good results with the injected fat, the technique he described never became popular.

It was not until 30 years later that Lyndon Peer took a scientific look at fat grafts (3). Using studies of open incision fat grafting, he concluded that approximately 50% of the fat tissue survived after he cut them into small pieces and transplanted them into donor sites. Peer's reports stimulated surgeons to use dermal fat grafts on a limited basis. Interest in fat grafting increased with the advent of liposuction. Liposuction provided plastic surgeons with a valuable byproduct—semiliquid fat that could be grafted with relative ease using a needle or small cannula. Initial reports of fat grafting were discouraging and claimed that grafted fat had a survival similar to injectable collagen (4,5).

In 1986, I began to transplant fat into iatrogenic liposuction deformities and subsequently into faces. Even some of my earliest attempts at fat grafting yielded long-term structural changes that had every indication of permanence. In 1988, I presented my positive experiences with fat grafting at the American Society of Aesthetic Plastic Surgery annual meeting. By 1995, 7 years after one procedure, these same patients demonstrated continued corrections (6). Transplanted fat has the potential to survive as a permanent living graft.

Plastic surgeons now accept the potential longevity of fat. However, many complain that they cannot obtain consistent results. The survival of free autografts of any human tissue (skin, bone, cartilage, cornea) is extremely dependent on the technique used. Likewise, the dependability of grafting fat is related to the technique used to harvest, refine, and transfer the fat.

It is not enough to graft fat so that it survives. The grafted fat must be placed appropriately to accomplish the desired objectives. The surgeon must become familiar with the levels of placement (subdermal, intramuscular, suprapariosteal), and the amounts necessary at each level to accomplish a desirable change. The amounts vary with each part of the face and body, as well as from patient to patient, and a discussion of the subject is beyond the scope of this chapter. However, the subject has been discussed extensively (7–10).

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## PREPARATION

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Determining the amounts to be placed and the levels in which the fat should be placed to create subtle or gross contour changes of the face and body requires a sophisticated plan. The surgeon must evaluate the patient's appearance and be knowledgeable about the patient's lifestyle, expectations, prior aesthetic procedures, and medical history. Patients should be informed of the details of the planned procedure, the expected outcome, and the postoperative course. Of particular importance for structural fat grafting is preparing the patient for the postoperative swelling and bruising.

Photography documents the preoperative appearance and provides guidance for three-dimensional analysis. Physical examination of the face or body is essential to supplement photographic documentation because photographs cannot capture the relationships of underlying structures and the skin. A surgeon grafting fat should have a strategy for placement in order to predict the volumes required, the levels of placement, and the structural support anticipated.

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## TECHNIQUE

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The technique discussed below emphasizes respect for handling tissues and basic sound surgical technique. Fatty tissue is delicate human tissue and can be injured easily outside the body by mechanical, barometric, and chemical insults. For successful transplantation, fat must survive harvesting, transport, and implantation as an intact parcel of tissue composed of connective tissues as well as adipose cells.

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## Harvesting

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I select harvesting sites that are convenient for access and that enhance the patient's contour. The abdomen and medial thighs are the most commonly chosen donor sites. When abdominal or medial thigh fat is in short supply because of prior liposuction or scarcity of body fat, the other potential sites include the suprapubic region, the anterior or lateral thighs, the knees, the lower back, the hips, or the sacrum.

Whenever possible, harvesting sites are accessed through incisions placed in creases, previous scars, stretch marks, or hirsute areas. Meticulous sterile technique is observed with preoperative preparation using antimicrobial scrubs and prep solutions.

Local anesthesia is most commonly used, but epidural or general anesthesia may be preferred for removal of larger volumes or when multiple sites are used for harvesting. In local anesthesia cases, a blunt Lams infiltrator attached to a

10-mL syringe is used to infiltrate 0.5% lidocaine with 1:200,000 epinephrine into the desired sites. To ensure hemostasis in general or epidural cases, lactate Ringer solution with 1:400,000 epinephrine is infiltrated. In all situations, about 1 mL of solution is infiltrated for every milliliter of fat to be harvested. Superwet or tumescent techniques of the harvested tissue can disrupt the parcels of fatty tissue and decrease survival.

A 15- or 23-cm two-hole Coleman harvesting cannula with a blunt tip and dull distal openings placed extremely close to the end of the cannula is twisted onto a 10-mL Luer-Lok syringe. The distal openings of the harvesting cannula are of an appropriate size and shape for harvesting the largest intact fatty tissue parcels that can readily pass through the lumen of a Luer-Lok syringe. If the fatty tissue parcel can pass through the lumen of the Luer-Lok syringe, it will usually pass through the much smaller (17-gauge) lumen of the infiltration cannula.

After inserting the cannula tip into the donor site, the surgeon pulls back on the syringe plunger to create a small amount of negative pressure within the barrel of the syringe. A 10-mL syringe is small enough to be manipulated manually without locking devices in order to minimize negative pressure. The surgeon pulls back on the plunger of the syringe to create about 1 or 2 mL of space in the barrel of the syringe while the attached cannula is pushed through the harvest site. The combination of slight negative pressure and the curetting action of the cannula's motion through the tissues allows parcels of fatty tissue to move through the cannula, through the Luer-Lok aperture,

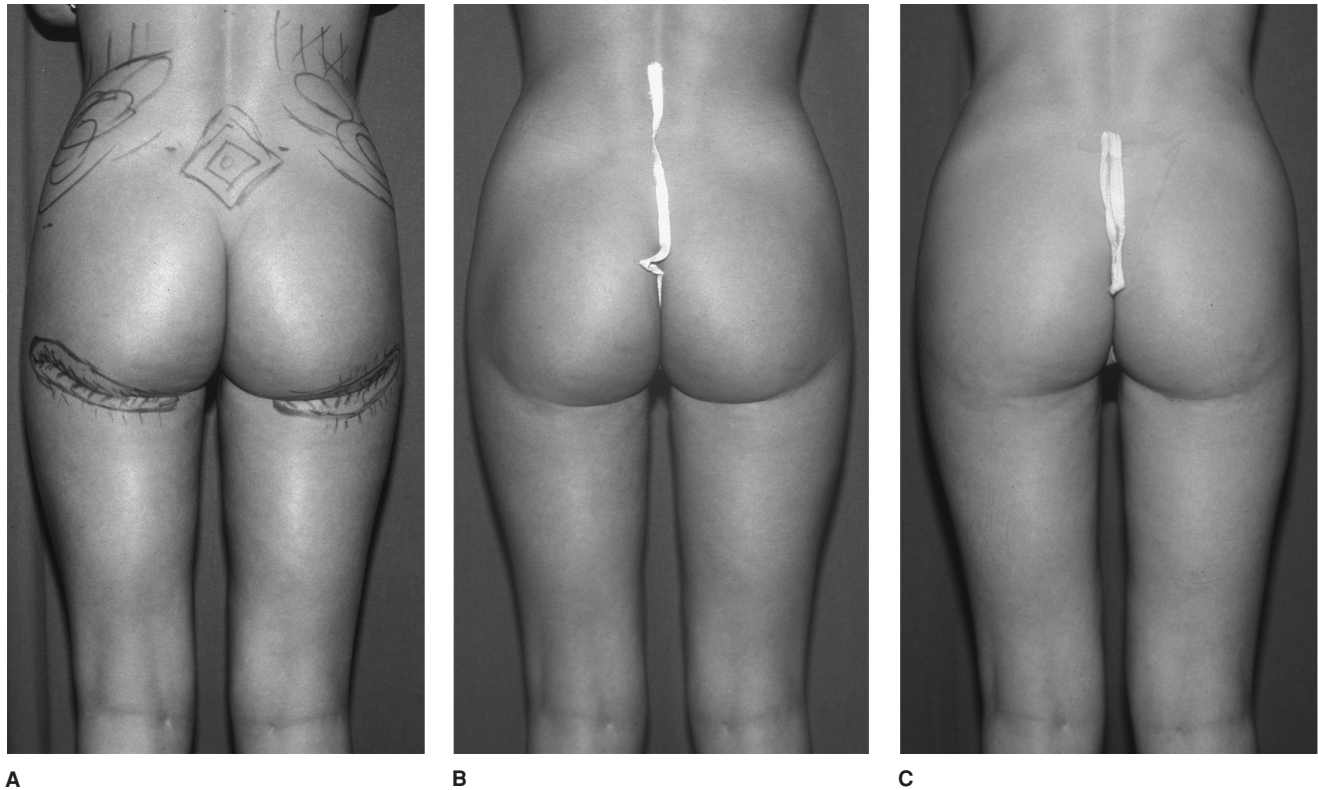
and into the barrel of the syringe with minimal mechanical damage.

When filled, the syringe is then disconnected from the cannula and replaced with a "dual-function Luer-Lok plug for capping." After the syringe is sealed at the Luer-Lok end, the plunger is removed from the proximal end of the syringe and the barrel filled with 10 mL of harvested material is placed into a centrifuge.

### Refinement and Transfer

Refinement of the harvested subcutaneous tissue into relatively pure fat is crucial for predictable fat grafting. The amount of nonliving components harvested will depend on the quantity of liquid injected by the surgeon, the amount of blood in the harvested specimen, and the damage to fatty cells that releases lipids. Harvested tissue can have as little as 10% viable fat or as much as 90% viable fat, even when coming from the same site during the same operation. To obtain predictable results, most of the oil, blood, and aqueous components must be removed so that the surgeon can know how much of the specimen is viable fat.

To promote sterility, a centrifuge with a sterilizable central rotor and sleeves that hold a 10-mL syringe should be used. The recommended centrifugation speed is 3,000 revolutions per minute for 3 minutes. This separates the denser components from the less-dense components to create multiple layers. The upper level, or the least-dense layer, is

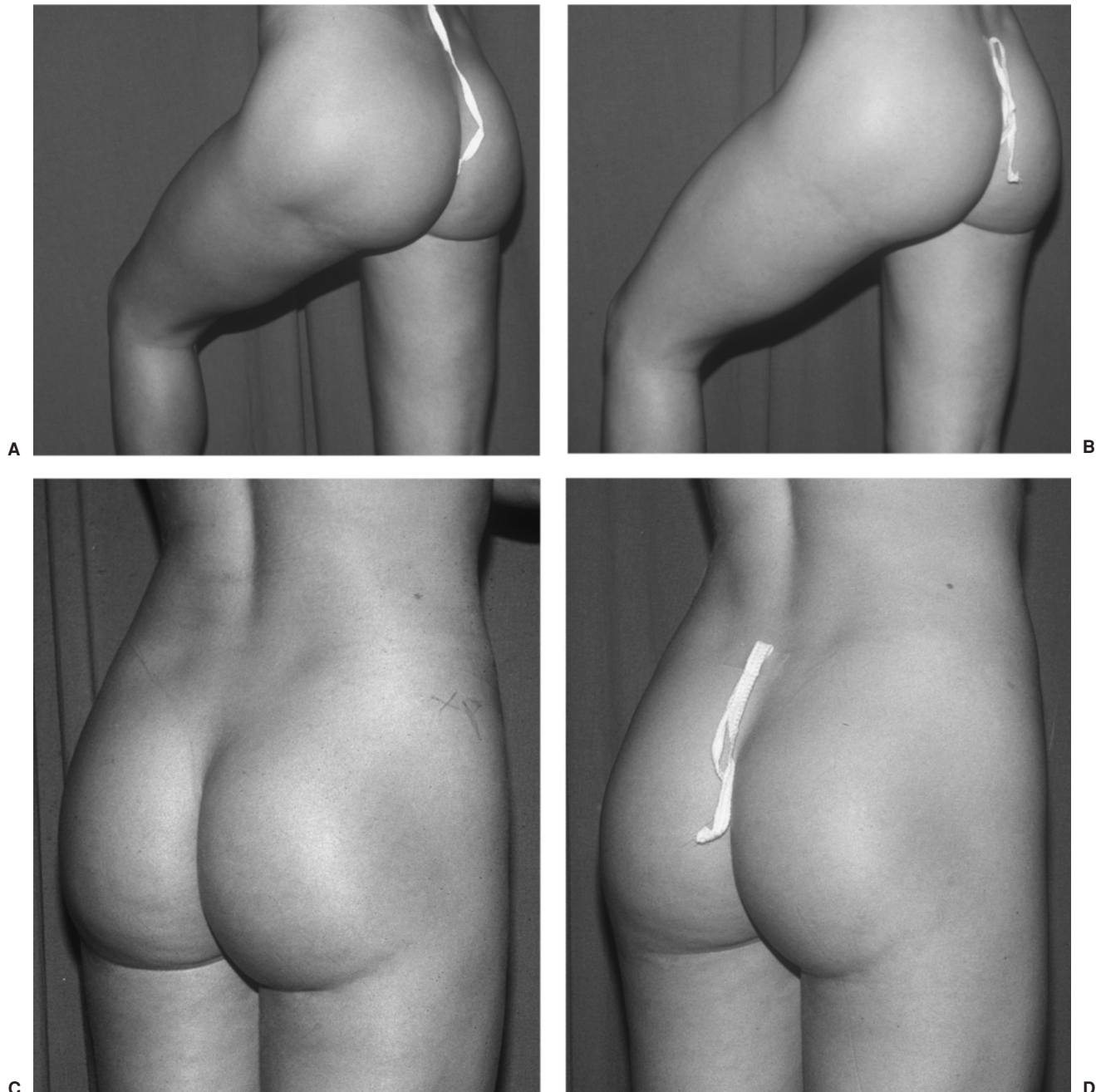


**FIGURE 47.1.** Fat grafting to correct depressions in buttock creases resulting from liposuction 11 months earlier. The markings in (A) demonstrate the areas of removal and placement of fatty tissue. From the love handles and back, 260 mL of fatty tissue was harvested and refined into 183 mL of usable tissue, of which 77 mL was infiltrated into the right buttock crease depression and 105 mL into the left. Comparison of the before (B) and 19 months later (C) images demonstrates filling of the lateral buttock creases on both sides, as well as expansion of the trochanteric regions.

primarily made up of oil. The middle portion is made up of potentially viable parcels of fatty tissue, and the lowest, most-dense level, is primarily made up of blood, water, and lidocaine.

The oil layer is decanted from the syringe, before the Luer-Lok plug is removed. After the oil is decanted, the Luer-Lok plug can be removed. Neuropads or other highly absorbent materials can be used to wick off the remaining oil from the exposed end of the harvested fat by capillary action. Care should be taken not to allow the material from the wicks to shred off into the refined tissue. After 4 minutes, the wick

can be replaced with another if oil remains. After changing the wick two or three times, the plunger is replaced into the barrel of the 10-mL syringe. This is done by allowing the fat to slide down to the edge of the syringe barrel then advancing the plunger to obliterate the dead space. The fat is then transferred into a 1-mL Luer-Lok syringe. The most efficient manner is to inject the fat directly through the Luer-Lok aperture of the 10-mL syringe into the barrel end of a smaller Luer-Lok syringe. The plunger of the smaller syringe is then replaced. Although 3-mL Luer-Lok syringes can be used for placement into most areas of the body, only 1-mL



**FIGURE 47.2.** Lifting the leg in (A) demonstrates the depth of the left lateral thigh depression and the correction at 1 year to normal in (B). Evaluation of the right buttock crease from the left oblique photo (C) demonstrates a significant volume and contour change at 19 months (D) with the grafted fat bridging the buttock and thigh.



Luer-Lok syringes should be used for placement into the face and hands.

### Placement

The most challenging part of fat grafting is placing the refined fat into a recipient site to encourage uniform survival, stability, and integration into the surrounding tissues. The fatty tissue parcels must be positioned so that they are separated from each other as much as is possible by the host tissues. This creates a larger surface area of contact between the harvested fat and the recipient tissues so that diffusion and respiration can take place.

Anesthesia for placement can be with local anesthesia, regional blocks, and/or general anesthesia. Regardless of which is used, an epinephrine solution is advised for vasoconstriction in the face to minimize the potential for accidental cannulation of arteries or veins (11). The use of a blunt Coleman infiltration cannula is convenient for infiltration of solution into the recipient site and tends to minimize damage to blood vessels and resulting ecchymosis or hematomas.

Placement is best accomplished with a blunt Coleman infiltration cannula with one distal aperture just proximal to the tip. The instruments used for placement of fatty tissue are dramatically different from those used for harvesting—they are of a smaller gauge with only one hole at the distal end. The proximal end of the cannula has a hub, like the harvesting cannula, that fits into a Luer-Lok syringe. The most useful cannula size is 17 gauge. However, larger bore cannulas can be used for corporal fat grafting, and smaller bore cannulas may be appropriate in some instances, such as in the lower eyelids. In the face, 7- and 9-cm cannulas are the most useful; longer cannulas, up to 15 cm, can be useful in the body. For varying situations in the face and body, cannulas with different tip shapes, diameters, lengths, and curves can be used (10).

The use of blunt cannulas is encouraged to allow placement of the fat parcels in a more stable manner. However, less-blunt cannulas give the surgeon more control for placement in the immediately subdermal plane, in fibrous tissue, and in scars. A cannula with pointed or sharp elements can be used to free up adhesions, but care should be taken to avoid damage to nerves and other underlying structures.

Through the same incisions that were used for infiltration of local anesthesia, the infiltration cannula is inserted and advanced through the recipient tissues into the appropriate plane. No fatty tissue should be ejected during the advancement of the cannula. Once the tip of the cannula is placed into the target

location, the plunger of the 1-mL syringe is pressed slightly while the cannula is being withdrawn. This deposits fatty tissue in the pathway of the retreating blunt cannula. Unlike the sharp tip of a needle, the blunt tip does not cut a defined channel through the recipient tissues. With the advance of the blunt cannula, the natural tissue planes separate in a somewhat physiologic fashion. As the cannula is withdrawn, the deposited fatty tissue parcels fall into the natural tissue planes as the host tissues collapse around them.

The fatty tissue parcels should be deposited in the desired location, shape, and volume with each pass of the infiltrating cannula so that the surgeon places the fat into the desired shape and volume. Accuracy of this initial placement is important because the infiltrated fatty tissue cannot easily be remodeled afterward. If a cyst or clump forms accidentally, digital manipulation can sometimes flatten minor irregularities. However, the tissue should never be placed with the idea that digital pressure can change the shape after placement.

Separating the parcels of fat one from the other not only increases the chance of survival by placing the newly transplanted fat parcels in greater contact with a source of nutrition and respiration, but also encourages better fat adherence and stability in the new recipient sites. Finally, placing the fat in small parcels and separating every parcel with the donor-site tissues integrates the grafted fat into the tissues. The newly grafted fat feels like the tissue into which it is placed.

Placement of miniscule linear increments is critical to maximizing the surface area of contact and minimizing the potential for irregularities or clumps of tissue. In the face, the largest amount of tissue that should be placed with each withdrawal is 0.1 mL, but in some areas, such as the eyelids, the maximum placed should be closer to 0.03 mL or even 0.02 mL per withdrawal of the cannula.

The end point of placement varies widely between anatomic areas. In the lateral malar cheek and mandibular border, the appearance at the conclusion of infiltration of fat will be similar in shape and size to the final outcome. Conversely, such areas as the lips, eyelids, or hands will be grossly distorted and not resemble the desired outcome for weeks after placement.

### Postoperative Care

Placement of fatty tissue as described above will create remarkable swelling in the recipient tissues. The patient should be prepared for a significant recovery period. Even though most patients are presentable at 2 to 4 weeks, they should be prepared for some minimal swelling lasting up to 16 weeks.



FIGURE 47.3. Markings demonstrate the planned placement of fat into specific areas of facial lipoatrophy without much feathering into the surrounding areas. On the right side of the face, 5.8-mL of fat was placed; 6 mL was placed on the left. (A) Anterior view. (B) Bird's eye view.

Care after fat transplantation should be aimed at minimizing swelling and stabilizing the area to avoid migration. Elevation, cold therapy, and external pressure with elastic tape help prevent swelling. Other maneuvers, such as holistic medications and electromagnetic therapy, are yet unproven, but may accelerate the resolution of swelling.

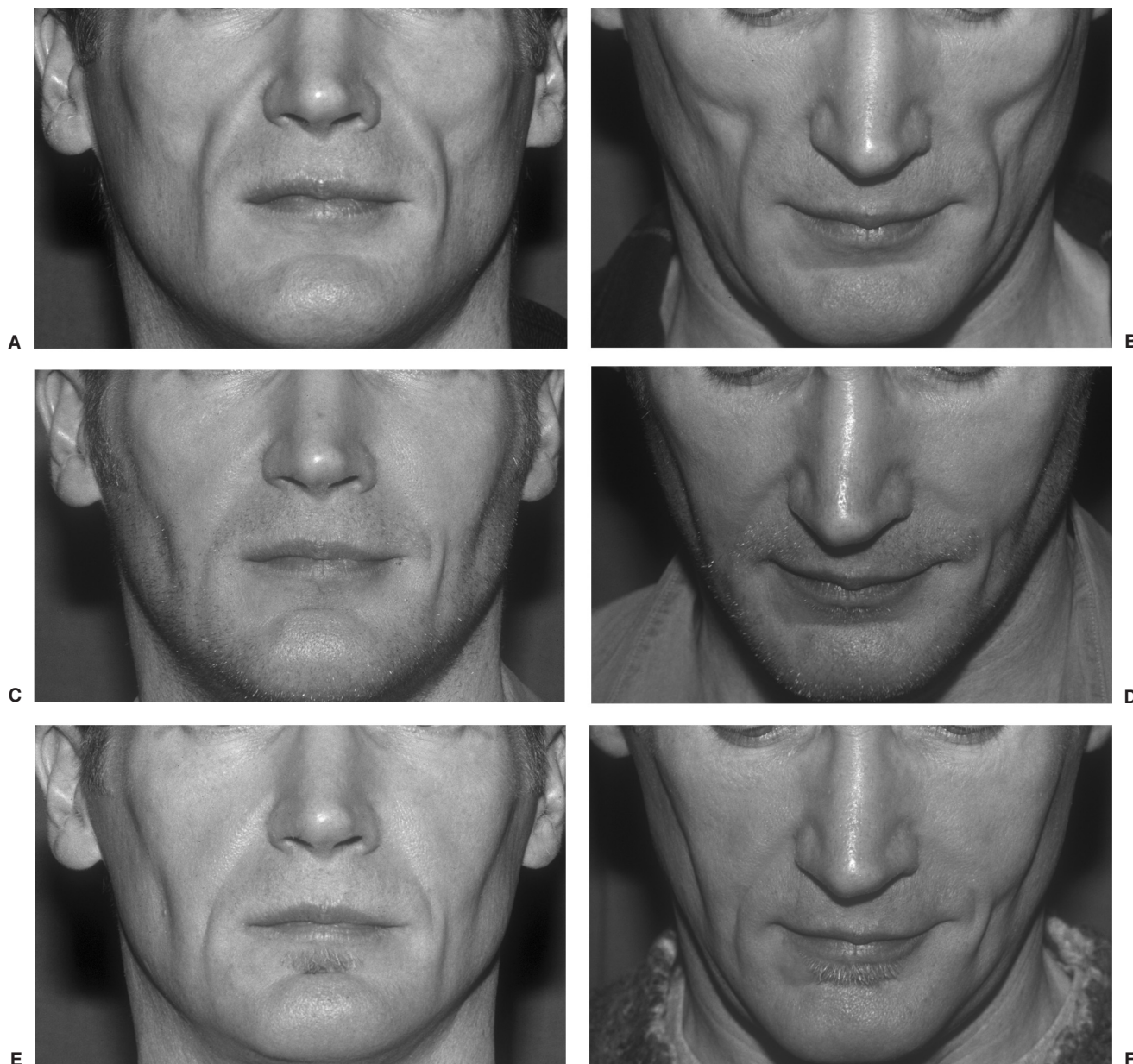
## COMPLICATIONS

Because structural fat grafting is performed through tiny incisions primarily using blunt cannulas, complications are minimal compared to open aesthetic procedures. Incisions should be placed in a direction and position to minimize the possibility of noticeable scars, and closed with interrupted monofilament

sutures. To decrease the possibility of infection, sterile technique should be observed at all times and precautions taken to avoid intraoral or mucosal contamination.

With insertion of even a blunt cannula for removal and placement, it is possible to damage underlying structures such as nerves, muscles, glands, and blood vessels. For that reason sharp needles or cannulas should be used with great caution. Of particular concern with the placement of any filler substance is the cannulation of arteries or veins and intravascular emboli (11). Fortunately, the complication rate with fat grafting is extremely low compared to most open surgical techniques and the incidence of problems decreases dramatically with experience.

The most common complications of fat grafting are related to aesthetic appearance, such as too much or too little fat in a specified area. The next most common problem is the



**FIGURE 47.4.** Same patient as Fig. 47.3 with drug-related lipoatrophy, correction of the anterior malar and buccal regions imparts a much healthier appearance. **A, B:** Before the single procedure. **C, D:** Four months after one treatment. **E, F:** Forty-two months after the procedure with no other treatment. Note that there is almost no difference between the 4-month photographs and the photographs after 42 months. The volume of the fat changes little with this technique after 4 or 5 months.

presence of irregularities, which can be from the intrinsic nature of the patient, from the technique used for placement, and from migration after placement. Irregularities after fat grafting diminish remarkably with experience.

This is a brief summary of some of the more common or noteworthy complications, and a more exhaustive list of potential and experienced complications can be found elsewhere (10).

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## PATIENT EXAMPLES

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The patient examples for this chapter were chosen to represent the simplest application of structural fat grafting: filling a well-defined deficiency to restore a contour to its normal and former appearance.

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### Patient 1

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The first patient is a 22-year-old female who presented 11 months after liposuction to the lateral thighs and buttock creases left her with unnatural-appearing exaggerations of her buttock creases and deep depressions extending into the lateral thighs. Markings (Fig. 47.1A) demonstrate the areas of fat tissue grafting. She is shown before (Fig. 47.1B) and 19 months after one fat grafting procedure (Fig. 47.1C).

In Figure 47.2, note the obvious depression of the lateral thigh and buttock crease that is corrected by placement into the buttock crease. Also note the improvement of the relationship of the lateral buttock with the thigh so that they have a more continuous, flowing, and youthful-appearing relationship. On the oblique view above, the buttock flows smoothly into the thigh in the after photographs. Often the patient will know a maneuver such as lifting the thigh (Fig. 47.2C and D) that best demonstrates the deficiency and resulting correction.

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### Patient 2

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The second example is a 45-year-old healthy male with drug-related facial lipoatrophy of gradual onset. He requested correction of his anterior cheeks only, which were filled with

5.8 mL of fatty tissue on the right and 6 mL on the left in the distribution shown in Figure 47.3. The tissue was harvested from the abdomen, and the refined fat was placed using a Coleman type I cannula from three incisions on each side: a lateral malar incision, an anterior border of the mandible incision, and an incision at the lateral commissure. The volume of the placed fatty tissue seemed to stabilize by about 4 months, and the 4-month appearance appears similar to that at 3.5 years (Fig. 47.4).

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## CONCLUSION

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The key to successful fat grafting is planning and attention to technique. The technique involves the purposeful placement of a specific volume of fat in tiny aliquots that allow a large surface area of contact between the host tissues and the newly grafted tissue. This large surface area of contact not only promotes nutrition and respiration, but also stabilizes the placed fat to deter migration and integrates the fat so that it feels like fullness rather than discrete collections of fatty tissue.

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