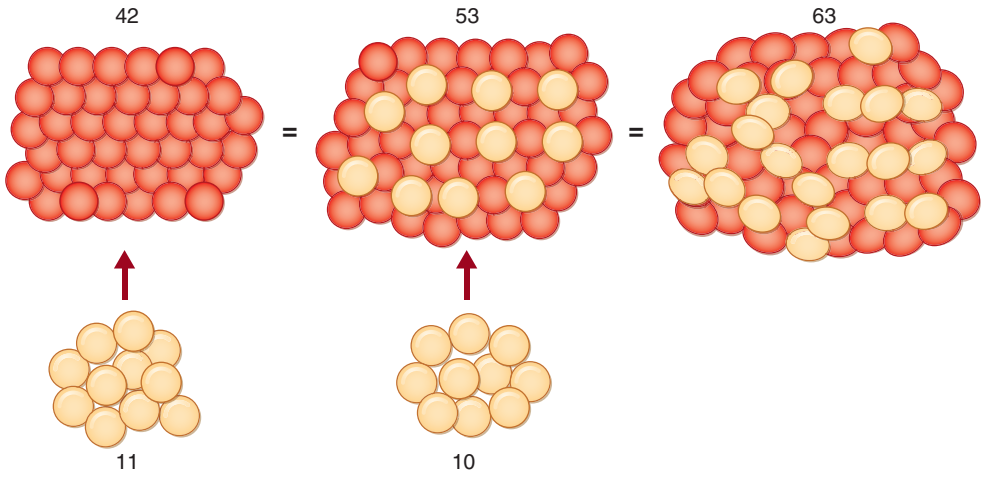

Figure 7.7 Eleven 4 mm yellow droplets can be evenly spread inside a 42 droplet-sized recipient bed without crowding, coalescence, or increased IFP of the recipient. However, squeezing another 10 droplets results in two problems: (1) confluence as droplets coalesce to become >4 mm and endup with central necrosis; and (2) an inability of the recipient bed to expand enough to accommodate the additional size increase, upon which IFP will rise to choke the circulation and cause additional necrosis.

For successful mega-volume fat grafting, we should never graft beyond the physical capacity of the recipient to accept the added amount of tissue. We monitor this by measuring IFP in a fashion similar to compartment pressure measurements (Fig. 7.7).

Recipient Site Vascularity. Most recipient sites have sufficient vasculature to support their own metabolism but not enough to support large grafts. The capillary density of the recipient is a critical factor. The higher the density, the closer every microfat graft droplet is to a capillary.

Ability to Differentiate Necrotic Cysts from Cancer. Particularly in the breast, radiologists in the past could not differentiate between necrotic cysts and cancer. However, technological advances in radiology have made this challenge obsolete.[7]

To overcome the first three obstacles of fat grafting, and generate the live block of tissue required for the reconstruction, we must create a 3-D, well-vascularized, biocompatible scaffold that can be seeded with cells and connected to the endogenous host system. This is the holy grail of tissue engineering. Researchers have attempted to create scaffolds with titanium substrates, poly(L-glutamic acid), poly(L-lysine), and many others. Instead of chemically synthesizing a scaffold, we have harnessed the regenerative capabilities of mechanical forces to induce the body to generate its own 3-D, well-vascularized scaffold in situ.

Fat grafting was originally pursued for its ability to add volume and fill cavities. However, a growing body of evidence suggests that adipose-derived stromal cells (ASCs) in adipose tissue have great regenerative potential.[5] Once they receive adequate vascular support, ASCs differentiate and proliferate to regenerate tissues similar to their surroundings. Thus, by using mechanical forces along with tiny pricks that can mesh-expand the tighter structures, we generate 3-D recipient scaffolds. Then, seeding this construct with adipose tissue, we harness the body's endogenous regenerative capabilities to tissue engineer reconstruction that would have classically required flap transfers.[1,8]

GENERAL FAT GRAFTING TECHNIQUES[9,10]

FAT HARVEST

For fat harvest we favor fat from deposits that fluctuate less with body weight. We ask the patient to avoid gaining weight before the surgery and, if possible, to lose some weight so the grafts enlarge with return of original weight. In patients with no localized deposits, we harvest a thin layer over a large surface. We cannot directly visualize the fat harvested from the cannula tip, so we employ the "sprinkler system" of "evenness through randomness." We use a cannula with a diameter in the 2 mm range so that we can enter through needle puncture holes and harvest a few microribbons along long criss-crossing arcs. These puncture sites require no suturing and essentially leave no scar, allowing multiple entry sites. For a typical trochanteric fat harvest site, we use at least eight entry sites with a 14G hypodermic needle.

To estimate donor site availability, we use the "Palm & Pinch Test." The surface area of a surgeon's palm is about 200 cm^2, so if a patient's anterior thigh has a surface area of five "Palm Measures" and a depth of 0.25 cm of fat, we can harvest about 250 mL of fat per thigh. We rarely turn away patients for lack of fat stores.

According to our experience, fat harvesting is most efficient with a 12-hole cannula at a constant pressure of 300 mmHg K-VAC syringe (Fig. 7.8). This is a handheld, spring-loaded syringe that provides this constant pressure along the entire excursion of the plunger due to rolled ribbon springs, similar to measuring tape coils.

FAT PROCESSING

We use an atraumatic transfer valve (AT-Valve) that transfers the lipoaspirate from the K-VAC syringe to the collection container without switching syringes and cannulas. It is a flutter type valve that does not clog with tissue, has a wide bore, and a low-pressure gradient. It automatically transfers the lipoaspirate harvested in the K-VAC syringe to the collection bag as the syringe spring is cocked again.

Figure 7.8 Lipografter™ set up in harvesting mode. A 12G, 12-hole cannula is connected to the K-VAC spring-loaded syringe via the AT-Valve. Fat is drawn into the syringe as the plunger is pulled by the ribbon springs of the K-VAC at a constant 300 mmHg vacuum pressure along its entire excursion. Pushing the plunger back down re-cocks the ribbon's springs, and the AT-Valve ensures that the lipoaspirate is automatically sent to the collecting bag.

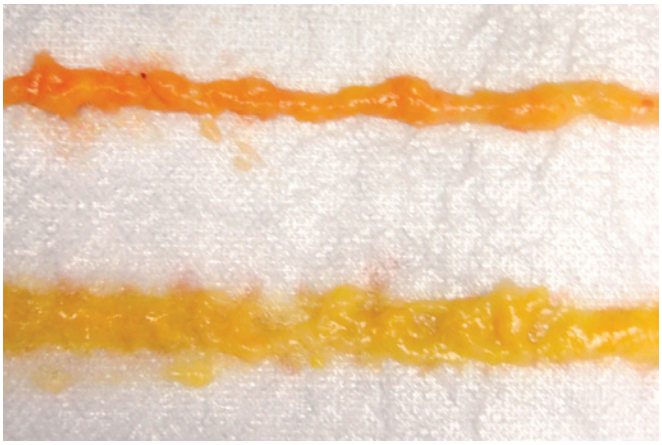

Figure 7.9 Paste-like appearance of compacted fat from lipoaspirate centrifuged at 1200*g* (top), compared with the loose slurry of lipoaspirate centrifuged at 15*g* (bottom).

The collection container is then centrifuged at 15*g* for 2 min, using a hand-cranked centrifuge. Alternatively, it is allowed to hang for 15–20 min at 1*g*, normal gravity sedimentation. After draining the infranatant fluid, the collection container becomes the graft delivery container.

Compared with the 1200 g Coleman fat processing technique (Fig. 7.9), low-*g* centrifugation or simple sedimentation provides several advantages:

1. It is less traumatic to the delicate adipose tissue.
2. The loose lipoaspirate is less likely to clog the thin-bore grafting cannula.
3. The dilute suspension provides an added margin of safety against over-grafting, since part of the graft is fluid that is readily reabsorbed.

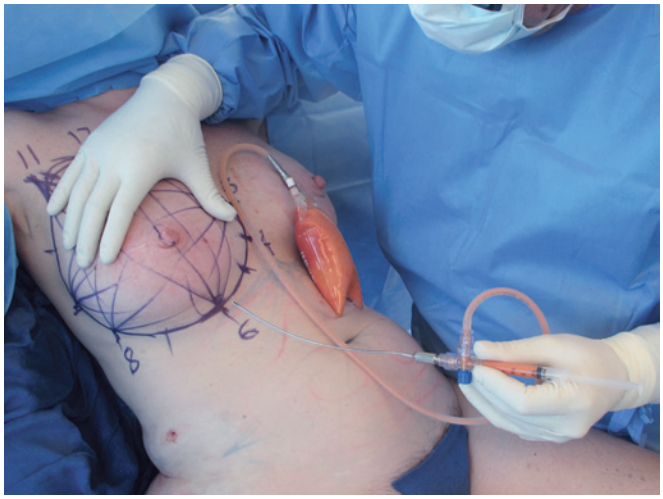

Figure 7.10 14G single-hole spatulated tip grafting cannula connected to a 3 mL grafting syringe via the AT-Valve in grafting mode. Thanks to the valve, fat can be repeatedly aspirated from the collection bag into the syringe and automatically injected back through the cannula into the breast. A small, 3 mL syringe allows precise delivery of fine micrografts as a mist. The economy of motion by not having to switch and reload syringes saves operative time.

4. Lipoaspirate contains many beneficial factors such as plasma, platelets, and growth factors that we prefer to preserve instead of discarding with stronger centrifugation.
5. The excess fluid places the restrictive fibers under tension and allows their selective cutting with needle tips with the Rigottomy technique. This release is bloodless due to epinephrine from the tumescent liposuction being present in dilute lipoaspirate.

FAT DELIVERY

For fat injection, we use a 14G cannula with a single hole just proximal to the spatulated tip. The distal third is curved to better follow the contour of the breast, and it is either 15 or 25 cm long, depending on the grafting site. Grafting is performed with the same syringe and container as harvesting, but with the AT-Valve in reverse mode. Injection sites are made with a 14G hypodermic needle. The spatulated tip creates a 0.1 cm^2 (2.5 mm×4 mm) recipient cleft, so each pass with the 25 cm cannula delivers about 2.5 mL (0.1 mL/cm of tunnel). This theoretically ensures that no adipocyte is >1.3 mm from a recipient capillary (Fig. 7.10).

To avoid coalescence and contour deformities, we use multiple entry sites to inject microribbons of fat as individual channels carefully inserted in separate plains: subpectoral, intrapectoral, subglandular, subdermal, and subcutaneous. Subdermal and subcutaneous are preferred because they expand most with Brava, and augmenting superficial planes yields more projection than deeper planes. Intrapectoral injections are ideal in immediate reconstruction because the restrictive fascia has been removed, and grafting can be done under direct vision.

A clock-face marking of the breast can be used as a reference. In the lower half, we fan out multiple radial passes a few degrees apart, placing the ribbons in subdermal or