Aesth. Plast. Surg. 19:427–437, 1995

Aesthetic Plastic Surgery

Liposuction Fat-Fillant Implant for Breast Augmentation and Reconstruction

Lee Hang-Fu, M.D., Gary Marmolya, M.D., and David H. Feiglin, M.B.B.S., B.S.

Lakewood, Ohio, USA

Abstract. The perfect breast implant fillant material would have higher viscosity than water and would be autologous and harmless. We describe the confinement of liposuction fat in implants using the Lipovacutainer during a routine liposuction procedure. This collected fat is prepared inside the Lipovacutainer and is reinjected through a Lipomedia filling cannula into a leaf valve implant as the fillant in place of saline. The implants are used for bilateral augmentation mammoplasty and breast reconstruction procedures. Our six clinical cases have been monitored closely using mammography and MRI. These cases showed slow liquefaction without interference with mammography studies. We obtained excellent overall body contours. All complications were correctable and non-life-threatening and there was no capsule formation.

Key words: Fat fillant — Autologous — Liquefaction — Lipovacutainer — Implants

Since the final ruling on the use of silicone implants made public by FDA Commissioner David A. Kessler, M.D., there has been increased effort in the search for an inert substance to replace silicone as the fillant in breast implants. A variety of experimental substances ranging from plasma extract to peanut oil [7,9] have been considered, but have proved unsuccessful.

One source of augmentation material is autologous fat [4,5,20]. Though used 80 years ago [2], its use declined with the introduction of silicone. Also contributing to the disuse of autologous fat were the associated side effects of nonviable fat transfer. For example, all free injected adipocytes may result in focal necrosis, foreign body reaction, and fibrosis with infiltration of macrophages, giant cells, and calcium deposits [1,3]. These processes appear to progress up to nine months postinjection until eventually the injected fat sites are replaced with fibrosis and minimal, if any, adipocytes [1]. These side effects of autologous fat augmentation have limited its (wide) acceptance as a breast augmentation substance, and they often explain the clinically noted atrophy of augmented sites, which can be 50% or more of the initially injected volume [6,14,16–18].

Free fat for correction of body contour defects is well accepted and considered an excellent technique. However, any free fat injection in breast tissue has become a highly controversial and a much cautioned against procedure [8,10–13,15,19]. Fibrotic changes with calcification seen on breast mammography can cause a significant number of false positive identifications of breast cancer. Therefore, postinjection fat necrosis and fibrosis with calcification are significant complications in the detection of breast cancer.

In our limited series of clinical augmentation mammoplasty procedures. We have replaced normal saline with the patient's liposuction fat in a saline implant. This process eliminates some of the complications discussed earlier. Since fat has a higher viscosity than normal saline with a similar texture and feel as normal breast tissue, it seems logical to replace saline with autologous liposuction fat.

One of the major advantages in using autologous fat as the fillant is the avoidance of other controversial material. Since the fat is confined, theoretically the implanted fat will not be subjected to body inflammation and fibroblastic infiltration. Therefore, fibrotic changes and calcification are limited, if not elimi-

Presented at the Lipoplasty Society of North America, New Orleans, Louisiana, USA, 17–19 September 1993

Correspondence to Lee Hang-Fu, M.D., Cleveland Cosmetic Surgery Consultants, 14601 Detroit Ave., Suite 250, Lakewood, OH 44107, USA

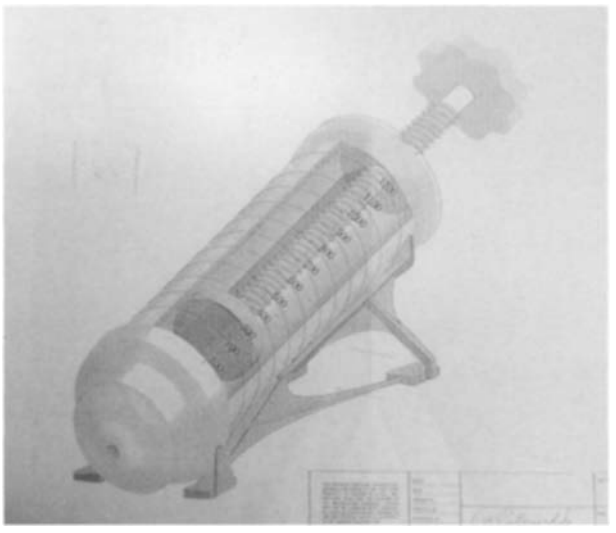

Fig. 1. Lipovacutainer from Lipomedia: two-chamber design for filtration of fat during collection; and converts to a fat-injecting container. (Reprinted with permission)

nated. Fat confined in an implant shell for a prolonged period of time will undergo necrotic liquefaction, and in the absence of infection, no putrification decomposition will take place [20]. Invariably, some osmotic shift of fatty acids will occur through the semipermeable silicone implant. Theoretically, these fatty acids will be absorbed by the body tissue or will calcify and likely be confined within the capsule and thus be easily identified on mammography. Another advantage of using autologous fat is that valve leakage of solid or liquified fat should be less than normal saline since the viscosity of fat is higher and it can provide a better pressure seal over the leaf valve. Finally, this method uses otherwise discarded fatty tissue from the (most) frequently performed cosmetic liposuction procedure to augment breasts and is an excellent means of total body contouring and breast augmentation.

Material and Method: Fat Harvesting

Fat harvesting and collection is accomplished with a standard setup of liposuction utilizing saddlebags, lovehandles, lower abdomen, buttocks, and medial thighs for sites of fat donation. Our personal preference is to use a wet liposuction technique. We are able to obtain a greater amount of bloodless fat for reinjection using the wet technique, and the viability of fat globules is not a concern in this procedure.

Since 400 cc or more of pure fat is often needed in most breast augmentation procedures, we recommend using a large multihole cannula to simplify and maximize overall fat collection. The collected fat must be drained in a strainer, which is loaded inside the Lipovacutainer canister from Lipomedia (Warrensville Heights, OH, USA) (Fig. 1). The strained mixture of blood and liquid fat is kept in a separate trap container and is allowed to settle and separate. The top layer of the liquid fat may be used as implant fillant. Once an appropriate amount of fat is obtained, the Lipovacutainer can be converted into a fat reservoir injection gun which is then used to fill the empty implant shell. As prophylactic treatment an antibiotic can be added through the side port of the tubing.

The liposuction incision should be sutured appropriately, and the patient should wear a girdle binder for an appropriate postoperative period.

Augmentation Mammoplasty

After using the standard accepted method to create a subglandular or a submuscular space, we prefer to use an anterior or a posterior leaf valve implant shell for augmentation mammoplasty. We select an implant size that is 20 cc larger than required. This is to allow a softer, more natural feeling to the postaugmentation result, with no balloon effect. Once the implant is selected, the Lipomedia cannula is inserted into the leaf valve to extract the air. The cannula is then connected to the Lipovacutainer injection gun through a plastic tubing. The entire assembly is now ready for the filling process.

Part of the collected fat fillant is injected from the Lipovacutainer into the implant by turning a quick screw knob (Fig. 1). The partially filled implant is then inserted into the breast and the rest of the filling is completed with the implant in the pocket. Once the desired volume is obtained, the Lipomedia filling cannula is removed and the opposite breast is completed to the surgeon's specifications. We prefer brassiere support postoperatively. This is followed by massage starting on the third postoperative day.

Indications and Case Review

Our procedure is indicated for a woman who prefers total body recontouring utilizing liposuction for reshaping, followed by augmentation mammoplasty using otherwise discarded autologous fat as implant fillant. This combines two procedures into one and maximizes the overall appearance of the patient.

Case 1

Our first case was a 34-year-old nurse, mother of two, 5′6″ tall, and weighing 130 lb (Fig. 2). Preoperative bra size was AA cup and there was no history of breast surgery. Using liposuction, a total of 600 cc of fat was collected from her saddlebags, waist and, posterior upper buttocks. After rinsing and preparation of the

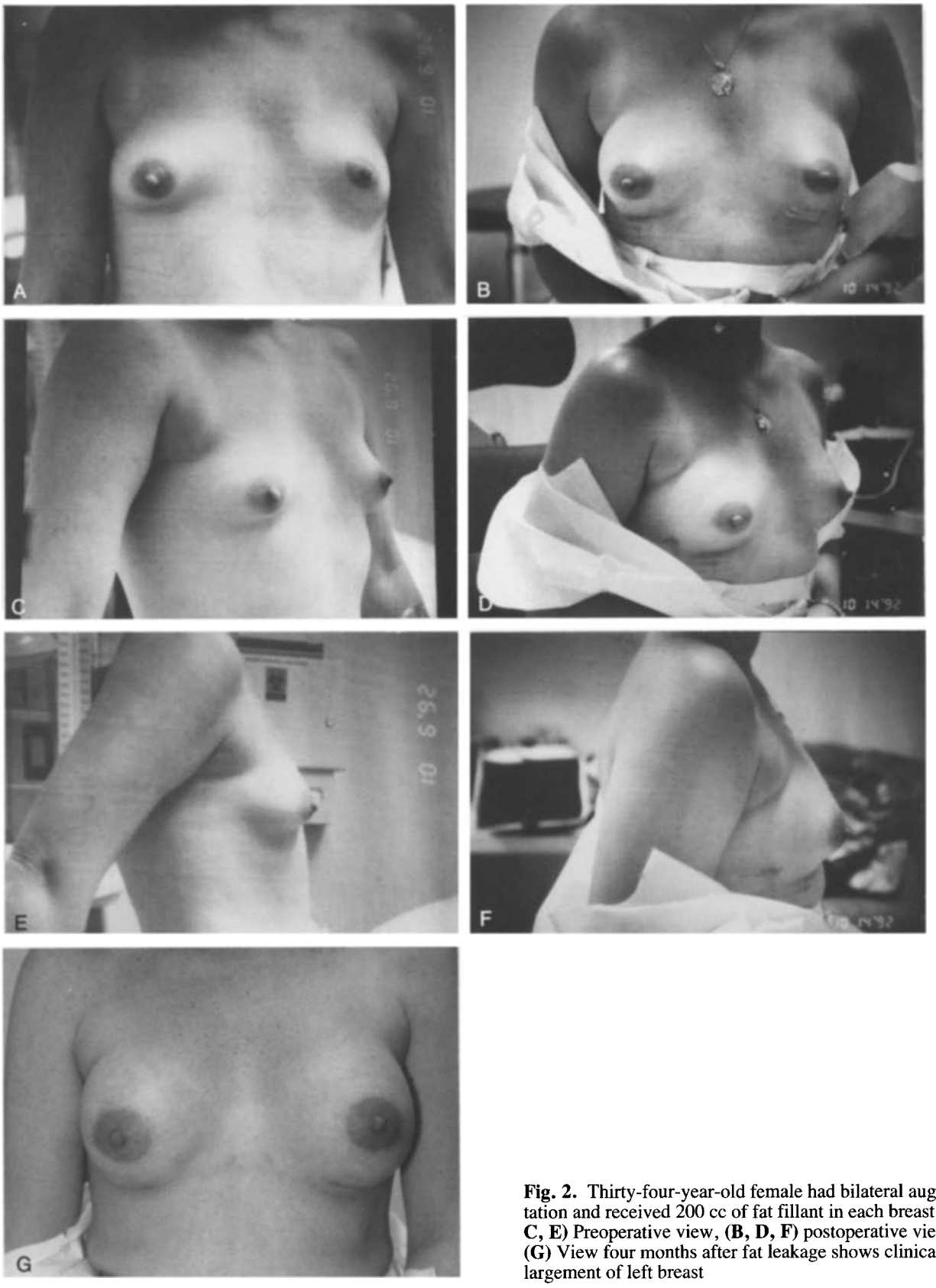

Fig. 2. Thirty-four-year-old female had bilateral augmentation and received 200 cc of fat fillant in each breast. **(A, C, E)** Preoperative view, **(B, D, F)** postoperative view. **(G)** View four months after fat leakage shows clinical enlargement of left breast

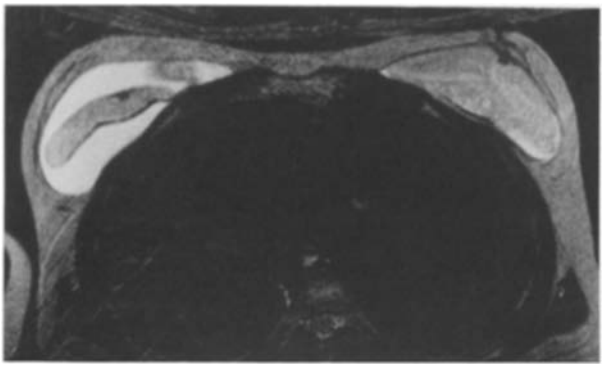

Fig. 3. MRI demonstrating bright seroma around collapsed leaky implant

collected fat, 200 cc of fat fillant were injected in each saline implant for her augmentation mammoplasty.

Four months later, the left implant developed a leak from an undetected rupture of the valve caused by forcefully inserting a large Lipomedia cannula (problem has since been corrected). Clinically, her left breast enlarged to 1.5 times the size of the right breast without erythema. Clinical ptosis was also noted on the left breast (Fig. 2G). This enlargement developed over three to four months but was slightly evident within one month of radiologically detected leakage.

When the implant was removed we found that both fibrous capsules were filled with a large amount of sero-fatty fluid which was evident clinically on her MRI (Fig. 3). Some of the remaining fatty content within the implant was submitted for histological examination and culture. Histology showed few viable fatty cells with negligible inflammatory reactive macrophage cells. These are distinguished from necrotic fat cells, with lack of inflammatory reaction due to confinement inside the implant (Fig. 4). Reimplantation was performed by transferring the remainder of the fatty fillant to a new posterior leaf valve implant and supplementing the rest of the volume with normal saline. The patient has been symptom-free for the last 18 months.

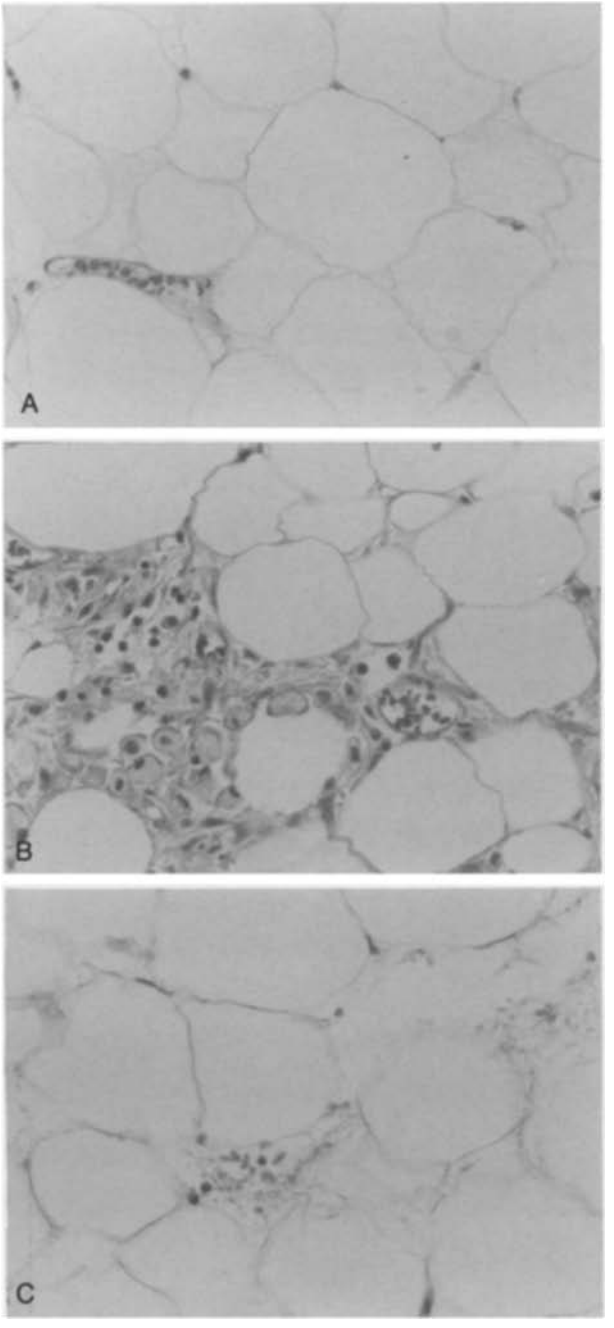

Fig. 4. **(A)** Normal fat histology, **(B)** necrotic fat with extensive inflammation, **(C)** confined necrotic fat fillant from a leaky implant with minimal inflammatory reaction

Case 2

The second case was a 39-year-old career woman, mother of two, 5′6″ tall, and weighing 140 lb. Preoperative bra size was A cup with mild ptosis and there was no history of breast surgery. Using the described technique, a total of 750 cc of fat was obtained from her thighs and buttocks. A total of 325 cc was injected into each implant during her bilateral augmentation mammoplasty (Fig. 5). No complications were evident eight months postoperatively.

Case 3

Case 3 was a 32-year-old hospital ward secretary, mother of two, 5′2″ tall, and weighing 110 lb. Preoperative bra size was B cup and there was no history of breast surgery. A total of 550 cc of fat was obtained bilaterally from thighs, hips, posterior upper buttocks, and lower abdomen as the source of donor sites. A mixture of 275 cc of fat fillant and 25 cc of saline was

Fig. 5. A 39-year-old female had bilateral augmentation and received 325 cc of fat fillant in each breast. **(A, C, E)** Preoperative view, **(B, D, F)** postoperative view

placed in each implant for augmentation mammoplasty (Fig. 6). There have been no complications over eight months postoperatively.

Case 4

The next case was a 29-year-old attorney's wife, no children, 5′6″ tall, and weighing 145 lb. Preoperative bra size was B cup with no ptosis. A total of 800 cc of pure fat was collected from her buttocks. The right implant received a total of 285 cc of fat fillant and the left got 300 cc (Fig. 7). There have been no complications over eight months postoperatively.

Case 5

This 37-year-old mother of two, 5′2″ tall, and weighing 123 lb recently had a left modified radical mastectomy followed by immediate breast reconstruction using tissue expansion during the first stage. She received a total of 720 cc of expansion over six weeks. During the second stage of reconstruction three

Fig. 6. A 32-year-old female had bilateral augmentation and received 275 cc of fat fillant and 25 cc of saline in each breast. **(A, C, E)** Preoperative view, **(B, D, F)** postoperative view

months later she received 350 cc of fat fillant collected bilaterally from thighs and hips (Fig. 8). Although her reconstructed left breast is larger than desired, it is extremely soft on palpation. There have been no complications six months postoperatively.

Case 6

Our last case was a 22-year-old exotic dancer, 5′9″ tall, weighing 140 lb with mild ptosis of A cup breasts. She had one aborted pregnancy four years prior and no history of breast surgery. A total of 1000 cc of fat was collected bilaterally from her thighs, upper posterior buttocks, and medial thighs. She received 300 cc of pure fat fillant in each breast during her bilateral augmentation mammoplasty (Fig. 9). Two months later, the patient experienced erythema and enlargement. This condition had apparently been ongoing for about two weeks prior to her return to the office at which time her breasts were approximately three times larger than her initial postoperative appearance. She was afebrile with no sign of bacteremia.

The implants were removed along with a large amount of serous fluid from within the fibrous capsule of both breasts. The implants' content was black with an extremely foul odor detected during removal. Only

Fig. 7. A 29-year-old female with bilateral augmentation and received 285 cc of fat fillant in the right breast and 300 cc in the left breast. **(A, C, E)** Preoperative view, **(B, D, F)** postoperative view

the implants' contents demonstrated the presence of bacteria after histological examination and culture, gram positive bacilli (Fig. 10). After extraction of the implants the wound was irrigated and closed in the usual manner. One week after explantation and preventive oral antibiotics, the patient developed a small amount of seroma without progressive reaction or systemic infection (Fig. 11).

Radiological Studies

Each patient received one MRI examination during her first two-month postoperative period and at six-month intervals thereafter. One patient will receive a monthly MRI in an attempt to demonstrate the liquefaction process. All patients will have an initial mammogram six months postoperatively and will be followed annually by mammographic examination.

The postoperative MRI showed a thin implant outer margin with intact fatty fillant. The fat fillant essentially shows the same magnetic density as viable fat in the surrounding tissue. Using fat suppression imaging techniques, preinjected liposuction solution and rinsing saline solution were demonstrated at a gravity-dependent area within the implant shell. No inflammation was seen inside the implant shell or within the

Fig. 8. A 37-year-old female had immediate breast reconstruction and received 350 cc of fat fillant in the left breast. **(A, C, E)** Preoperative view, **(B, D, F)** postoperative view

surrounding breast tissue (Fig. 12). Six-month postoperative MRIs demonstrated similar findings with an indistinguishable difference between solid and liquid fat. Because of the implant's unique and bright signal on MRI, it becomes easy to identify any changes in and around the implant such as edema, which would have a water-equivalent signal intensity. At six months all patients also had mammograms which demonstrated radiolucent breasts without obliteration of normal breast tissue during cancer screening (Fig. 13).

Aside from the surgical and physiological advantages of autologous fat augmentation mammoplasty, the diagnostic quality of the mammograms was better compared with other augmentation materials. Silicone implants obscure breast tissue in front of or behind the implant. Though the "pinch" technique was developed to view as much breast tissue as possible, depending on the size of the breast it can be difficult to get optimal results. It is also difficult to obtain the occasional "cleavage" or "Cleopatra" view. One of the silicone implant's greatest drawbacks is that it makes it difficult to easily localize a lesion in two views. Even if one could localize a lesion, one could inadvertently puncture the bag while placing a needle and wire for a biopsy causing silicone to leak. Though these prob-

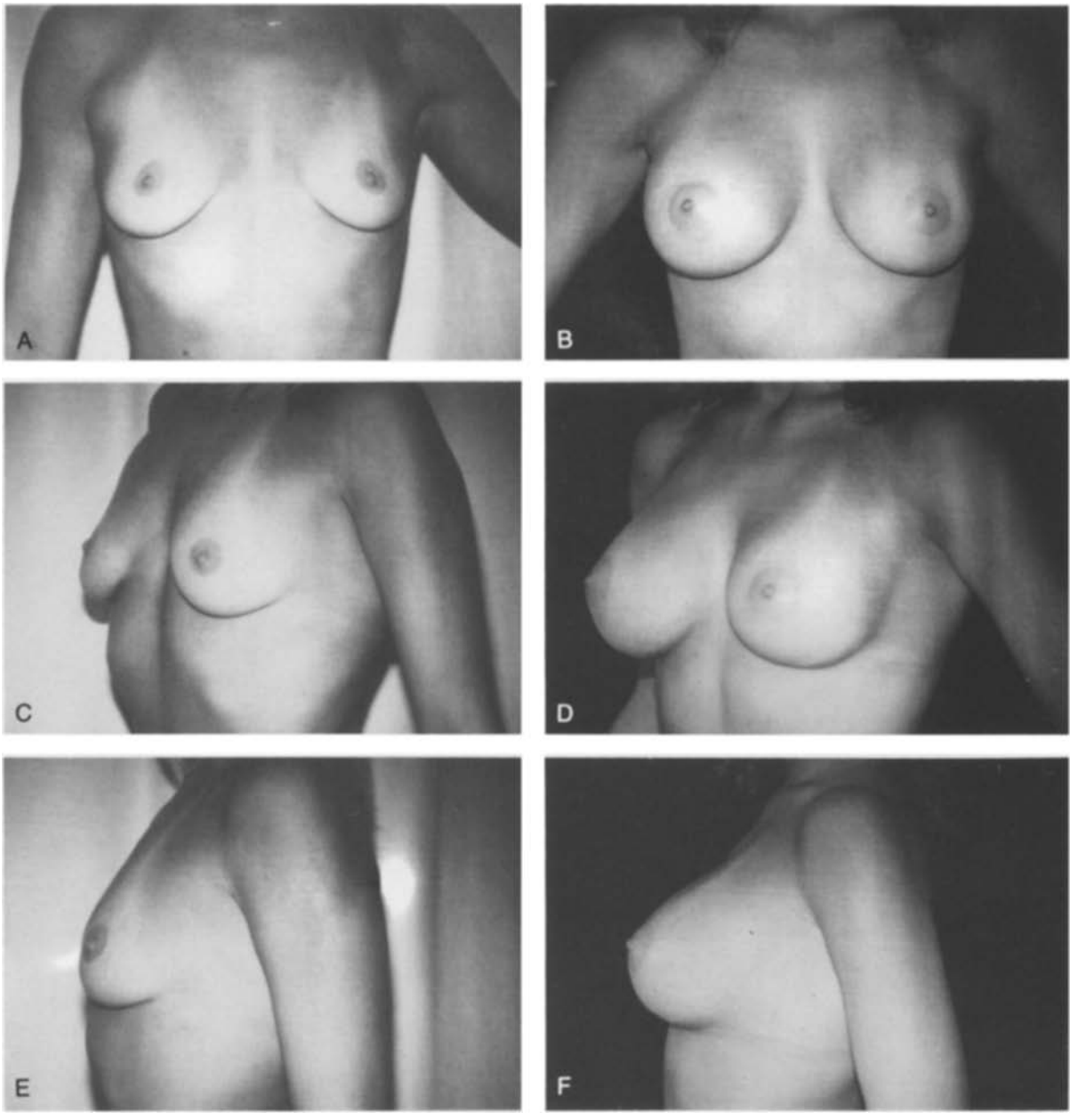

Fig. 9. A 22-year-old female had bilateral breast augmentation and received 300 cc of fat fillant in each breast. **(A, C, E)** Preoperative view, **(B, D, F)** postoperative view

lems are not present with the saline implant, it still has a faint "ground glass" effect on the surrounding breast material. Only the fat-filled implant allows an extremely clear image of the overlapping breast parenchyma which increases one's confidence in identifying microcalcifications.

Advantages and Disadvantages

There are several advantages of this technique. Autologous tissue does not exhibit reactive inflammation, rejection, or autoimmune disease. An excellent cosmetic result, including a natural feel to the breasts, is reproducible. There is abundant fatty tissue available at no extra cost. The procedure, performed in conjunction with liposuction, allows artistic body recontouring to complement augmentation mammoplasty for a new total-body look and satisfactory scars.

A disadvantage to this procedure may be a surgeon's lack of knowledge on contained nonviable fat metabolism. However, a surgeon can learn about central liquefaction of fatty tissue from that of cadavers which probably represents the fate of free fat fillant material in an implant [20]. Any fatty acid that osmotically shifts to outside the implant will theoretically be

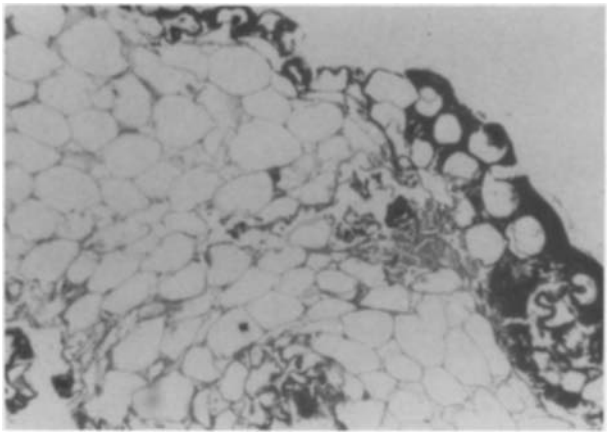

Fig. 10. Amorphous material produced by gram positive bacilli found within an infected fat fillant

Fig. 11. Case 6, one week after removal of implant with infected fat fillant

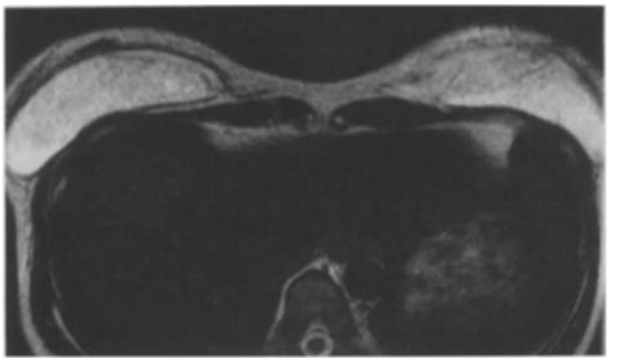

Fig. 12. MRI shows no inflammation noted around the implant

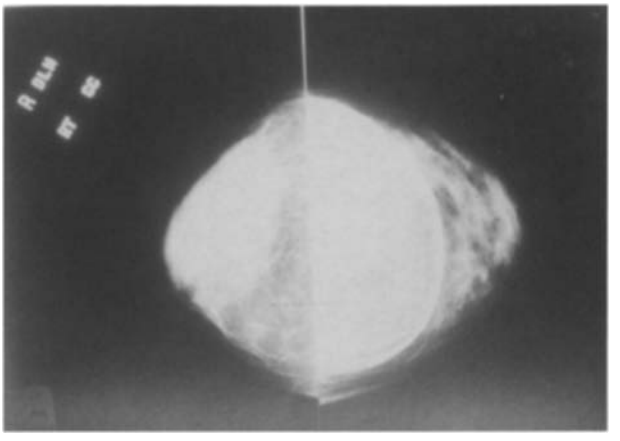

Fig. 13. Radiolucent mammography without obliteration during cancer screening

absorbed or form calcification deposits on the capsule. A large rupture or valve leak of liquid fatty acid is easily identifiable and can be repaired through the existing incision without an immunoreactive complication. There is the possibility of fatty emboli after a large rupture, but the risk may be extremely low because of the fibrous encapsulation process surrounding the silicone implant shell. Internal implant infection will develop a local chemical toxin reaction without bacteremia unless the implant ruptures.

Discussion

There are many complications associated with autologous free fat injection into breast tissue. By containing the liposuction fat in an implant shell, we have designed a simple procedure that has many advantages over other methods of augmentation mammoplasty. A perfect fillant should have higher viscosity than water and the same density as fat and should be autologous and harmless to the patient. Contained liposuction fatty tissue exhibits all of these properties. Once contained in a silicone implant, the fat is nonviable and will not undergo putrification unless it is infected. After a prolonged period in an implant, the fat will likely undergo liquefaction to form a liquid oil base of fatty acid with high viscosity [20]. This high viscosity prevents the implant shell from folding, maintains valve competency, and provides a soft, fatlike consistency. Since the autologous fat is contained, there is no reactive inflammation. Therefore, cellular infiltration and fibrosis with calcium deposits will not occur within the parenchymal breast tissue.

The semipermeable implant shell may permit microscopic osmotic movement of liquid fatty acid to outside the implant. The small amount of exposed liquid fatty acid will likely be absorbed by local tissue and any calcification will be confined within the fibrous capsule's inner wall.

The primary concern in designing augmentation mammoplasty should be the elimination of harmful

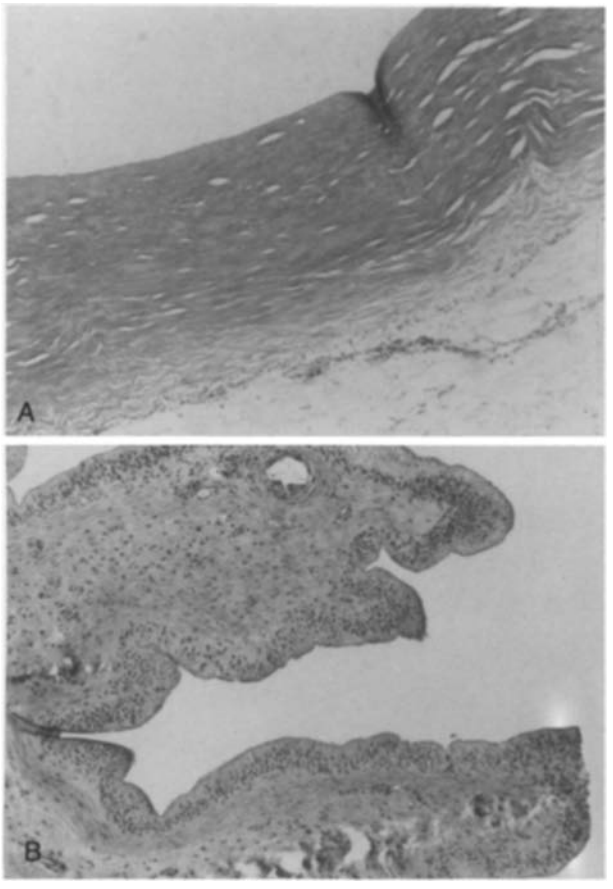

Fig. 14. **(A)** Extensive fibrous capsule of standard saline implant. **(B)** Fibroblasts response to autologous fat-filled implant

side effects to the patient. Autologous tissue is the only known natural substance without the likelihood of rejection. We realize that surgeons have expressed concern about the formation of intramammary fibrosis with calcium deposits that occurs with silicone and saline implants [8,10–13,15,19]. We believe that this complication has been controlled by encapsulating fat within an implant shell. Using autologous fat as fillant material inside an implant shell may improve detection of breast cancer on mammograms since fat fillant has a similar radiolucency as local breast tissue.

A well-trained surgeon, with the aid of radiology, can often detect and rectify a ruptured implant with significant leakage, as in case 1, without sequelae. Although fat emboli are a concern theoretically, the implant may prevent fat emboli if a large leak of liquid fatty acids occurs. Intraimplant infection is preventable by using appropriate antibiotics inside the implant. However, when there is infection, as in case 6, the bacteria are not permeable through the implant shell. Instead, there is a severe, but not life-threatening, local chemical reaction as toxin is released through the implant. This is correctable by simple explantation, antibiotics, and close observation. All patients should have an updated tetanus immunization. As in cases 1 and 3, the same technique was very effective in primary augmentation and reimplantation. The lack of a fibrous capsule in all these patients was not well understood (Fig. 14). However, micro-osmotic shift of liquid fatty acids may have prevented the formation of a fibrous capsule. This theory requires further study.

Conclusion

We realize that the use of autologous liposuction fat in implants for augmentation mammoplasty is a new field that needs further study. However, both basic science and actual clinical cases have shown great potential for the use of confined autologous liposuction fat as fillant for augmentation mammoplasty implants.

References

1. Agris J: Autologous fat transplantation: a three-year study. Am J Cosmet Surg **4:**95, 1987
2. Bier A: Fat transplant. Chir Kongr Verhandl **39:**189, 1910 (in German)
3. Bircoll M: Cosmetic breast augmentation utilizing autologous fat and liposuction techniques. Plast Reconstr Surg **79:**267, 1987
4. Bircoll M, Novack BH: Autologous fat transplantation employing liposuction techniques. Ann Plast Surg **18:**327, 1987
5. Chajchir A: Liposuction fat grafts in face wrinkles and hemi-facial atrophy. Aesth Plast Surg **10:**113, 1986
6. Chajchir A: Fat grafting injection for soft-tissue augmentation. Plast Reconstr Surg **84:**921, 1989
7. Destouet J, Eichling J, Gilula L: Radiolucent breast implant. U.S. Pat. 4,995,882, 1991
8. Dixon P: Autologous fat injection and breast augmentation (Letter). Med J Austr **149:**284, 1988
9. Ersek R, Beisang A: Bio-osmotic gel for implant prostheses. U.S. Pat. 5,067,965, 1991
10. Ettelson C: Fat autografting (Letter). Plast Reconstr Surg **80:**646, 1987
11. Fox B: Autologous fat injection and breast augmentation (Letter). Med J Austr **149:**284
12. Gradinger G: Breast augmentation by autologous fat injection. Plast Reconstr Surg **80:**868, 1987
13. Hartrampf C Jr, Bennett G: Autologous fat from liposuction for breast augmentation (Letter). Plast Reconstr Surg **80:**646, 1987
14. Illouz YG: Present results of fat injection. Aesth Plast Surg **12:**175, 1988
15. Linder R: Fat autografting (Letter). Plast Reconstr Surg **80:**646, 1987
16. Matsudo P, Toledo L: Experience of injected fat grafting. Aesth Plast Surg **12:**35, 1988
17. Newman J: Facial lipo transplant surgery. Am J Cosmet Surg **4:**131, 1987
18. Nguyen A: Comparative study of survival of autologous adipose tissue taken and transplanted by different techniques. Plast Reconstr Surg **85:**378, 1990
19. Ousterhout D: Breast augmentation by autologous fat injection (Letter). Plast Reconstr Surg **80:**868, 1987
20. Rosen P, Hugo N: Augmentation mammoplasty by cadaver fat allografts. Plast Reconstr Surg **82:**525, 1988