Prospective 1-Year Follow-Up Study of Breast Augmentation by Cell-Assisted Lipotransfer

Hae Kyoung Jung, MD; Chung Hun Kim, MD, PhD; and Seung Yong Song, MD, PhD

Abstract

Background: Breast augmentation by cell-assisted lipotransfer (CAL) may achieve a more natural breast contour than silicone implants. Moreover, certain complications associated with these prosthetic devices can be avoided with CAL. Few prospective studies of CAL have been performed to examine long-term volume changes, effects on breast parenchymal tissue, and the effect of stromal vascular fraction (SVF) on graft survival.

Objectives: In a 1-year prospective study of patients who underwent CAL, the authors examined changes in breast volume, effects on parenchymal tissue, and the impact of SVF on graft survival.

Methods: Following preoperative radiologic examination, patients underwent primary augmentation mammoplasty by CAL to both breasts. The SVF was characterized, and changes in breast volume were determined from magnetic resonance imaging studies performed postoperatively at 3 months and 1 year. A breast-imaging specialist reviewed all scans to detect changes in breasts.

Results: Five patients (10 breasts) were enrolled. Averagely 23% of grafted fat in volume was additionally harvested from each patient to isolate SVF cells. One year after CAL, breast volume had decreased to 47% of the initial postoperative volume. There was no parenchymal changes except small oil cysts. The ratio of SVF cell count to grafted fat volume showed no correlation with graft survival. Patterns of breast-volume decrease differed between older women with a history of breastfeeding and younger women without a history of breastfeeding.

Conclusions: The addition of SVF cells did not appear to improve the retention of grafted fat in these patients. Skin tension may be an important factor influencing the absorption pattern of grafted fat.

Level of Evidence: 4

Breast augmentation is a common aesthetic surgical procedure. Until recently, most methods of augmentation mammoplasty required placement of implants, which may result in complications such as capsular contracture, malposition, and implant failure. Implants also have been associated with anaplastic large-cell lymphoma and many patients who receive implants require secondary procedures within 10 years of the primary surgery.

Another available method of breast augmentation is fat grafting. Although fat grafting to the breast was initially criticized because of unpredictable results and possible

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complications (including fat necrosis and oil cysts), the
technique has become widely accepted in light of refine-
ments by many plastic surgeons and researchers.3-11 As is
well known, Coleman et al12,13 introduced the concept of the “structural fat graft,” which provided general guiding
principles of the procedure. Khouri et al14,15 developed
the BRAVA system, which can facilitate the engraftment of
grafted fat. Another important advancement is based on
the identification of adipose-derived stem cells (ASCs).16,17

In 2006, Yoshimura et al18 developed cell-assisted lipo-
transfer (CAL), which combines conventional fat grafting
with the injection of a stromal vascular fraction (SVF)
containing ASCs. The utilization of CAL for human breast
augmentation has produced satisfactory results and low
complication rates.19 It is believed that the beneficial
effects of ASCs on fat grafting are largely attributable to
their paracrine function; however, this has not been fully
elucidated.20-24 The main concerns regarding this proce-
dure are volume retention and the sequelae of fat necrosis
(e.g., oil cysts, calcifications, fibrosis). There have been few
studies on breast volume changes after augmentation with
CAL, and few investigators have screened their patients
prospectively for possible complications.

To determine the efficacy of this procedure, we assessed
breast volume and parenchymal changes radiologically, fol-
lowing augmentation mammoplasty by CAL. In addition,
we characterized the stem cells that were injected with the
fat graft.

METHODS

Patients

This study was approved by the institutional review board
of CHA Bundang Medical Center (BD2011-152D). From
January 2011 to March 2013, 5 women (10 breasts) were en-
rolled in the study. Written informed consent was obtained
from each patient. Only patients who agreed to participate in
the trial were included; therefore, participants were not con-
secutive. Eligible participants were healthy adult women
with a Breast Imaging Reporting and Data System (BI-RADS)
classification category of 1 or 2 on their screening breast-
imaging study, who adhered to our follow-up program for
the full year following the procedure. Those who did not
meet these criteria were excluded from participation. There
were no other requirements for study inclusion or exclusion.

Preoperative Evaluation

All eligible patients underwent magnetic resonance imaging
(MRI) of their breasts within 2 months prior to the operation.
In accordance with the American Cancer Society guidelines,
patients aged 40 years and older also received screening
mammography.25 Only patients whose BI-RADS score was 1
or 2 were eligible to participate in the study.

Surgical Procedures

After endotracheal administration of general anesthesia,
patients were placed in the prone position to enable har-
esting of fat from the posterior thighs and flanks. The tume-
scent solution consisted of 2% lidocaine (50 mL) and
1:100,000 epinephrine in Ringer’s lactate solution (1 mL).

Two stab incisions were made near the center of the
gluteal crease with a no. 11 blade. First, approximately 400
mL of tumescent solution was infiltrated manually into the
subcutaneous tissue of both posterior thighs and flanks.
Ten to 15 minutes later, liposuction was performed with a
Harvest-Jet (Human Med AG, Schwerin, Germany) and a
blunt cannula containing a 3-mm hole. The volume of fat
required for SVF isolation was determined at the outset of
liposuction and took into account the body mass index
(BMI) and fat-distribution pattern of each patient. The fat
for SVF isolation was harvest first, then delivered to a clean
bench for isolation. Additional fat for the graft was harvest-
ed over the next 1 to 2 hours.

After a sufficient amount of fat was harvested, the patient
was situated in the supine position. During the change of
position, some water in the harvested fat retained by the
Harvest-Jet was removed by its negative suction system.
After this process, no additional procedures were performed
on the fat (including centrifugation). Only the fat layer was
used for the graft, once it had been separated by gravity.

Two stab incisions were made in each breast (the areola
and the inferolateral area of chest wall) to permit insertion
of the injection cannula. The freshly isolated SVF was
mixed with the harvested fat, and the graft was placed into
the subcutaneous fat layer, retromammary space, and pec-
toralis major; caution was taken to avoid injection to the
breast parenchyma. A screw-type injector (Young Medical
Corp, Seoul, Republic of Korea) equipped with a 10-mL
syringe (Becton Dickinson, Rutherford, NJ) was used to
ensure even injection of small droplets. Approximately 0.28
mL of fat was injected during each rotation of the screw.
(Figure 1) In most cases, fat grafting to the subcutaneous
layer was achieved through the areolar incision, whereas

Figure 1. Screw injector (Young Medical Corp, Seoul,
Republic of Korea) for fat graft. By rotating a screw of the end
of the injector, small droplet of fat (about 0.28 mL) is injected.
grafting to the retromammary space and pectoralis major was done via the chest wall incision. To facilitate grafting, the areola was positioned anteriorly with a skin hook when necessary. Wounds were closed with 6-0 nylon, and non-compression dressings were applied to the breasts with skin adhesives; bandages and brassieres were not utilized. In general, the total operating time was approximately 4 hours. The harvest sites (thighs and flanks) were compressed with stockings or elastic bandages to reduce edema and promote early recovery. Analgesics were prescribed to control pain. After surgery, the patients were transported to a recovery facility and were discharged the next day.

**Isolation and Characterization of SVF**

The collected lipoaspirate was transported to the laboratory immediately, under sterile conditions, and was centrifuged at 400 g for 5 minutes. After removing the tumescent fluid, the adipose tissue was measured and recorded as the initial volume of adipose tissue obtained by liposuction. The adipose tissue was washed with an equal volume of phosphate-buffered saline + 2% gentamicin (warmed to 37°C), then centrifuged at 400 g for 5 minutes at room temperature. After careful removal of the top oil layer, the adipose tissue was mixed with an equal volume of warm (37°C) enzyme mixture containing trypsin (Sigma-Aldrich, St Louis, MO), dispase (Life Technologies, Carlsbad, CA), and collagenase I (Life Technologies). The fat tissue was digested for 60 minutes in a shaking water bath at 37°C. To stop the reaction, approximately 10 mL of the patient’s own blood was centrifuged at 1120 g for 5 minutes at room temperature, and the plasma was added to the digested tissue (5% of the total volume). After several washes in saline solution, followed by centrifugation and separation procedures, the majority of isolates were delivered to the operating room for injection. Small portions of isolates were delivered to the laboratory for cell characterization. This characterization process was conducted independently from the surgery. Aliquots of 10 μL were mixed with 10-μL trypan blue dye to enable assessment of cell viability. After hemolysis of red blood cells with distilled water, cell surface markers were analyzed to confirm the presence of SVF cells (positive

### Table 1. Patient Demographics

<table>
<thead>
<tr>
<th>Patient No.</th>
<th>Age (y)</th>
<th>Ethnicity</th>
<th>BMI (kg/m²)</th>
<th>History of Breastfeeding</th>
<th>Total Volume of Harvested Fat (mL)</th>
<th>Volume of Grafted Fat (mL), right/left</th>
<th>Fat Volume Utilized for SVF Isolation (cc)</th>
<th>SVF Cell Count</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>40</td>
<td>Asian</td>
<td>25.0</td>
<td>Yes</td>
<td>815</td>
<td>294/271</td>
<td>250</td>
<td>8.5 × 10⁶</td>
</tr>
<tr>
<td>2</td>
<td>39</td>
<td>Asian</td>
<td>19.6</td>
<td>Yes</td>
<td>625</td>
<td>333/192</td>
<td>100</td>
<td>64 × 10⁶</td>
</tr>
<tr>
<td>3</td>
<td>19</td>
<td>Asian</td>
<td>17.8</td>
<td>No</td>
<td>530</td>
<td>200/210</td>
<td>120</td>
<td>19 × 10⁶</td>
</tr>
<tr>
<td>4</td>
<td>41</td>
<td>Asian</td>
<td>20.1</td>
<td>Yes</td>
<td>462</td>
<td>204/138</td>
<td>120</td>
<td>18 × 10⁶</td>
</tr>
<tr>
<td>5</td>
<td>33</td>
<td>Asian</td>
<td>18.4</td>
<td>No</td>
<td>440</td>
<td>200/170</td>
<td>70</td>
<td>64.3 × 10⁶</td>
</tr>
<tr>
<td>Mean ± SD</td>
<td>34.4 ± 9.15</td>
<td>NA</td>
<td>20.18 ± 2.84</td>
<td>NA</td>
<td>574.4 ± 152.58</td>
<td>246.2 ± 62.99/196.2 ± 49.69</td>
<td>132.0 ± 69.07</td>
<td>34.76 × 10⁶ ± 27.14 × 10⁶</td>
</tr>
</tbody>
</table>

BMI, body mass index; NA, not applicable; SD, standard deviation; SVF, stromal vascular fraction.

### Table 2. Results of Breast Imaging Tests According to BI-RADS Classification Category

<table>
<thead>
<tr>
<th>Patient No.</th>
<th>Preoperatively</th>
<th>3 Months Postoperatively</th>
<th>1 Year Postoperatively</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Ultrasonography (category: result)</td>
<td>MRI (category: result)</td>
<td>MRI (category: result)</td>
</tr>
<tr>
<td>1</td>
<td>1: negative</td>
<td>2: benign cyst, 6 mm (left)</td>
<td>3: nodule, likely benign, 7 mm (left)</td>
</tr>
<tr>
<td>2</td>
<td>1: negative</td>
<td>1: negative</td>
<td>2: oil cyst, 5 mm (left)</td>
</tr>
<tr>
<td>3</td>
<td>1: negative</td>
<td>1: negative</td>
<td>1: negative</td>
</tr>
<tr>
<td>4</td>
<td>2: nodule, likely benign, 5 mm (right and left)</td>
<td>1: negative</td>
<td>1: negative</td>
</tr>
<tr>
<td>5</td>
<td>2: nodule, likely benign, 5 mm, palpable (right and left); pathologically confirmed to be adenosis tumor</td>
<td>1: negative</td>
<td>1: negative</td>
</tr>
</tbody>
</table>

BI-RADS, Breast Imaging Reporting and Data System; MRI, magnetic resonance imaging.
markers CD44, CD73, and CD105; negative markers CD31 and CD45). An aliquot of the SVF was cultured for 14 days to determine whether bacterial contamination had occurred during isolation procedures.

**Breast-Imaging Analysis and Techniques**

All imaging studies were interpreted prospectively by a single radiologist experienced in breast imaging. Findings were described according to the BI-RADS lexicon. The bilateral mammography included routine craniocaudal and mediolateral oblique views. Bilateral whole-breast ultrasonography was performed by the same radiologist with a linear-array transducer of 8 to 13 MHz (Aixplorer, SuperSonic Imagine, Aix-en-Provence, France; iU 22, Philips Medical Systems, Bothell, WA; or HDI 5000, Philips Advanced Technology Laboratories, Bothell, WA). MRI studies were performed with the patient in the prone position in a dedicated phased-array breast coil using a 1.5-T imager (Signa HDxt; GE Medical Systems, Milwaukee, WI). The MRI protocols consisted of axial T1-weighted fast spin-echo imaging, fat-suppressed axial and sagittal T2-weighted imaging, and dynamic contrast-enhanced examination by a fat-suppressed T1-weighted gradient echo sequence. In addition, standard subtraction images and kinetic curves were obtained.

### Table 3. Graft Survival Rate in Each Breast

<table>
<thead>
<tr>
<th>Patient No.</th>
<th>Side</th>
<th>Initial Breast Volume (mL)</th>
<th>Grafted Fat Volume (mL)</th>
<th>Fat Volume (mL)</th>
<th>Survival Rate (%)</th>
<th>Fat Volume (mL)</th>
<th>Survival Rate (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Left</td>
<td>497.74</td>
<td>294</td>
<td>126.23</td>
<td>0.429</td>
<td>214.17</td>
<td>0.728</td>
</tr>
<tr>
<td>2</td>
<td>Left</td>
<td>275.82</td>
<td>192</td>
<td>81.42</td>
<td>0.424</td>
<td>58.23</td>
<td>0.303</td>
</tr>
<tr>
<td>3</td>
<td>Left</td>
<td>323.13</td>
<td>138</td>
<td>71.43</td>
<td>0.518</td>
<td>55.5</td>
<td>0.402</td>
</tr>
<tr>
<td>4</td>
<td>Left</td>
<td>350.44</td>
<td>200</td>
<td>213.54</td>
<td>1.088</td>
<td>84.86</td>
<td>0.424</td>
</tr>
<tr>
<td>5</td>
<td>Left</td>
<td>248.71</td>
<td>200</td>
<td>106.90</td>
<td>0.535</td>
<td>105.31</td>
<td>0.527</td>
</tr>
<tr>
<td>1</td>
<td>Right</td>
<td>481.19</td>
<td>271</td>
<td>143.88</td>
<td>0.531</td>
<td>127.26</td>
<td>0.470</td>
</tr>
<tr>
<td>2</td>
<td>Right</td>
<td>284.91</td>
<td>333</td>
<td>90.24</td>
<td>0.271</td>
<td>61.23</td>
<td>0.184</td>
</tr>
<tr>
<td>3</td>
<td>Right</td>
<td>291.74</td>
<td>204</td>
<td>109.97</td>
<td>0.539</td>
<td>91.45</td>
<td>0.448</td>
</tr>
<tr>
<td>4</td>
<td>Right</td>
<td>420.68</td>
<td>210</td>
<td>302.40</td>
<td>1.440</td>
<td>150.1</td>
<td>0.715</td>
</tr>
<tr>
<td>5</td>
<td>Right</td>
<td>229.80</td>
<td>170</td>
<td>128.01</td>
<td>0.753</td>
<td>81.21</td>
<td>0.478</td>
</tr>
</tbody>
</table>

**Figure 2.** Changes in breast volume after augmentation by CAL. (A) Absolute volume changes in individual breasts. (B) Mean changes in breast volume. Dashed lines indicate estimated volume changes (not actual breast volume measurements) by magnetic resonance imaging.
Breast Volume Measurements and Analysis

Breast volume was determined according to the volume-rendering technique (Advantage Workstation Server, GE Medical Systems) by the same radiologist who interpreted all images. Each breast was outlined anteromedially along the inner surface of the skin and posteriorly along the anterior surface of the pectoral muscle on 1 of the axial T1-weighted fast spin-echo images (the plane with the highest anteroposterior diameter of the breast). The volume was measured 3 times for each breast in each MRI study. After excluding the most divergent value, the mean of the remaining 2 values was recorded. For each patient, breast volume was measured preoperatively as well as 3 months and 1 year postoperatively.

Statistical Analysis

Relationships between graft survival and initial breast volume, changes in breast volume, and SVF cell count were assessed by regression analysis. All statistical analyses were

Figure 3. Volume of retained fat after breast augmentation by CAL. (A) Graft survival rates for individual breasts. (B) Mean graft survival rate at each time point.

Figure 4. Ratio of fat volume to preoperative breast volume 1 year after augmentation by CAL. (A) Ratio of grafted fat to preoperative breast volume for individual breasts. (B) Mean ratio of grafted fat to preoperative breast volume at each time point.

Figure 5. Relationship between the volume of retained fat at 1 year and the ratio of SVF cell count to grafted fat volume.
RESULTS

Five patients were enrolled, and all 5 completed the study. For each of them, this was the first procedure performed on their breasts. The average age at the time of surgery was 34.4 years (range, 19-41 years). Two of the 5 patients were unmarried and had no history of breastfeeding. The average total volume of harvested fat was 574.4 mL, with 132.0 mL utilized for SVF isolation (Table 1). The mean number of SVF cells (including red blood cells) was $34.76 \times 10^6$ (Table 1). Cell surface markers were consistent with those known to be typical of SVF cells.26,27

Breast-Imaging Analysis

Changes in breast parenchyma according to BI-RADS classification are shown in Table 2. Oil cysts were detected in 3 of the 10 breasts and were located in the retromammary space. Patient 1 had a nodule at 3 months and 1 year. Follow-up imaging is being performed every 6 months, which will continue for 2 years, in accordance with guidelines of the American Cancer Society. BI-RADS category 3 is often a benign finding (> 98%).28

Breast Volume Measurements and Analysis

The amount of fat in the intra- and retro-pectoralis major was negligible; therefore, the volume analysis was focused mainly on anterior aspects of the pectoralis.

The mean breast volume decreased over time (Figure 2 and Table 3), and the pattern of volume changes varied among the breasts (Figure 3). To reflect the initial breast size, changes in the ratio of retained fat volume to preoperative breast volume were also analyzed. The pattern of volume changes also depicted in each breast (Figure 4).

The relationship between the fat volume that was retained at 1 year and the ratio of fat volume to preoperative breast volume was not significant ($P = .6862$, coefficient [95% CI] = $-0.1515 [-0.7090, 0.5346]$ (Figure 5).
linear regression analysis showed that the retained fat volume appeared to be negatively (but not significantly) associated with the ratio of fat volume to preoperative breast volume \( (y = 0.7822, P = 0.0765, R^2 = 0.3406) \).

### Relationship Between SVF Cell Number and Retained Fat Volume

To determine the effect of SVF on graft survival, the relationship between retained fat volume and the ratio of SVF cells to grafted fat volume was evaluated (Figure 6). However, no association was observed \( (P = 0.7105, \text{coefficient [95% CI]} = -0.1394 [-0.7031, 0.5429] \text{ at 3 months}; P = 0.4303 [-0.8266, 0.2954] \text{ at 1 year}) \). Moreover, no significant relationship was noted by simple linear regression analysis \( (P = 0.5867 \text{ at 3 months}; P = 0.2851 \text{ at 1 year}) \).

### Comparison Between Older Married Women With a History of Breastfeeding and Younger Unmarried Women Without a History of Breastfeeding

The quantity of retained fat volume was compared between the 3 married women with a history of breastfeeding (group 1: mean age, 40 years) and the 2 unmarried women with no history of breastfeeding (group 2: mean age, 26 years) (Figure 7). The mixed-model analysis showed significant differences between time points, groups, and group \( \times \) time (Table 4). Post-hoc analysis of estimated means (standard error [SE]) showed that the 2 groups differed significantly at all time points (Table 5.). Serial photographs of a patient from group 1 and group 2 are shown in Figures 8 and 9, respectively.

### Acute and Long-Term Complications

No acute complications occurred. The only long-term complication was the presence of small nonpalpable oil cysts, which occurred in 3 of the 10 breasts. Two breasts had a sole cyst and the other had multiple cysts.

### DISCUSSION

In this study, breast volume changes after primary breast augmentation by CAL were analyzed prospectively by MRI, an accurate method of volume analysis. In previous literature, despite the initial optimistic reports of the benefits of CAL, some investigators have reported that graft survival is not improved with this technique. The ratio of retained fat volume to initially grafted fat volume was approximately 0.47 in our study; however, this does not indicate that the graft survival rate was 47%. The fat-harvesting machine (Harvest-Jet) utilizes water to dislodge, wash, and harvest fat. Although the collection container has a filter, and negative pressure is continuously applied to remove excessive water, the harvested fat still contains a substantial amount of water. Therefore, the actual amount of fat volume on the day of operation was somewhat overstated. According to our preliminary results (data not shown), the volume of fat harvested by the Harvest-Jet is reduced to 45%, on average, after centrifugation at 1200 g for 3 minutes. If this is accurate, nearly 100% of the grafted fat had been maintained by 1 year postoperatively in our patients. Because it is difficult to precisely determine the actual volume of harvested fat, and the mechanism of grafted fat survival is early death and replacement, the true rate of graft survival with CAL remains uncertain.

Our analysis showed that the ratio of SVF cell count to grafted fat volume had no effect on the volume of fat retained. This finding is not consistent with the results of
Figure 8. Serial photographs of a 39-year-old woman (group 1) who had complained of small and asymmetric breasts. She underwent breast augmentation by cell-assisted lipotransfer, without any additional breast procedures. The patients is shown (A, D, G, J, M) preoperatively, (B, E, H, K, N) 3 months postoperatively, and (C, F, I, L, O) 1 year postoperatively.
Figure 9. Serial photographs of a 19-year-old woman (group 2) who had complained of small breasts. She underwent breast augmentation by cell-assisted lipotransfer, without any additional breast procedures. The patient is shown (A, D, G, J, M) preoperatively, (B, E, H, K, N) 3 months postoperatively, and (C, F, I, L, O) 1 year postoperatively.
animal studies or a previous clinical trial. A possible explanation for our finding is that the number of ADSCs was inadequate. Although there may be several causes, we believe that the most important relates to the amount of fat volume for SVF isolation. Because the angiogenic effects of ASCs are largely based on paracrine effect, potency is closely related to the absolute number of ASCs. Moreover, in clinical practice, particularly with Asian patients, the amount of available fat tissue is usually insufficient for breast augmentation by CAL. The original report of the CAL technique states that 4 times the volume of fat harvested for grafting is needed for SVF isolation.

However, in our study, only 10% to 50% of the harvested fat could be utilized for SVF isolation, which resulted in a low number of ADSCs. Therefore, SVF is not appropriate unless the patient has a sufficient quantity of fat for harvesting (typically BMI > 23). We believe that cultured ASCs should be used in the next generation of CAL breast augmentation.

Maintenance of volume is a major concern for patients and clinicians. In our study, approximately two-thirds of the grafted fat was retained for the first 3 months, and nearly half was present at 1 year. Thus, two-thirds of the fat absorption occurred during the first 3 months, and one-third occurred after 3 months. Although some volume loss is due to water resorption, this would not be common as late as 1 year postoperatively. We believe that another factor, remodeling, may be involved in such changes. However, this factor has not been fully elucidated.

In the left breast of patient 1, the volume of retained fat was larger at 1 year (214.17 mL) than at 3 months (126.23 mL) (Figure 2 and Table 3). In patient 4, the fat volume of both breasts at 3 months exceeded the immediate postoperative volumes (Figure 2 and Table 3), even though body weight changes in this patient were minimal during the first 3 months. Possible explanations for these findings include small variations in the landmarks utilized for volume measurements, temporary parenchymal increases/decreases, and slight changes in the patient’s posture during MRI studies. Moreover, it is possible that the absorption of oil droplets may be delayed by high skin tension and/or that the increased volume may reflect swelling. However, the radiologist measured each breast twice during every evaluation, so we believe that the data are accurate.

We observed different patterns of breast volume decrease after augmentation with fat grafting. The rate of fat absorption in the first 3 months was slower for the 2 younger patients (group 2) than for the 3 older patients (group 1). However, from 3 months to 1 year postoperatively, the volume loss was more rapid in the younger women. During preoperative physical examination, it was noted that group 2 patients (younger, unmarried, no history of breastfeeding) had tighter skin. A report by Kato et al describing the dynamic remodeling of grafted fat suggests that absorption of oil droplets is delayed in the presence of high skin tension. Our observed trend of a negative correlation between graft survival at 1 year and the ratio of grafted fat volume to preoperative breast volume (P = .07) further suggests that skin tension may be an important determinant of graft survival. Postoperative skin tension is a reflection of the ratio of grafted fat to initial breast volume. If an excessive amount of fat is grafted, skin tension will be high regardless of its initial condition. Therefore, graft survival depends on grafting the optimal amount of fat for each recipient. In this regard, a tissue expander such as Brava (Brava LLC, Miami, FL) may be beneficial.

Radiologic findings did not change considerably after the procedure. None of the oil cysts in our study was palpable; they were only detected radiologically. Oil cyst is an unexpected result of fat grafting, and it reflects a flaw in the engraftment process of grafted fat. Surgeons should aim to prevent this unexpected event. In our study, most oil cysts occurred in the retromammary space, indicating that this area may not be suitable as a “main” recipient site. Fat tissue and the SVF appear to have little effect on breast parenchyma. However, studies with longer follow-up, larger series of patients, and appropriate control groups are warranted to confirm or refute these findings and to draw more definitive conclusions about the efficacy and safety of CAL for breast augmentation. An obvious limitation of our study is the very small sample size (5 patients, 10 breasts); therefore, general conclusions cannot be drawn from it. Only nonparametric statistical analysis would have been possible (in cooperation with medical statistics specialists).

CONCLUSIONS

We observed that breast augmentation by the CAL technique does not improve the retention of graft volume long term in the current setting (23% enhancement of SVF). The degree of skin tension may be an important factor influencing the absorption pattern of grafted fat.

Disclosures

The authors declared no potential conflicts of interest with respect to the research, authorship, and publication of this article.

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