“SIEF”—Simultaneous Implant Exchange with Fat: A New Option in Revision Breast Implant Surgery

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Summary: A technique of implant exchange is reported using recipient-site preexpansion followed by autologous fat transplantation to the breast in 12 consecutive patients with breast implants who desired implant removal. Recipient-site preexpansion, used 2 weeks before fat grafting, may have both practical and theoretical benefits in increasing the breast subcutaneous space and stimulating the recipient-site microcellular environment overlying the prosthetic implant, allowing the subcutaneous insertion of a sufficient core volume of donor graft at the time of prosthetic explantation. In the cases described, the postexplantation breast volume at 9 months to 1 year postoperatively by quantitative three-dimensional imaging was equal to or greater than the preexplantation composite volume of breast and implant. Preexpansion before implant exchange with fat affords a more abundant space, completely independent from the subglandular or submuscular planes. In this new space, the “third space” of the breast, it is possible to technically place graft into the breast subcutaneous tissue and alleviate breast asymmetry resulting from pocket distortions caused by capsular contracture or by implant pocket drift. Observing breast augmentation with implants and with fat grafting in the same patient affords a unique opportunity to analyze some of the key differences between the two techniques. Recipient-site preexpansion and simultaneous implant exchange with fat (SIEF) should be added to the list of applications where fat grafting to the breasts may have early clinical utility and portends the use of fat used in conjunction with breast implants to achieve better patient outcomes. (Plast. Reconstr. Surg. 130: 1187, 2012.)

CLINICAL QUESTION/LEVEL OF EVIDENCE: Therapeutic, V.

Implant exchange is often performed for recipient-site soft-tissue problems, not for problems related to the implant per se. Historically, implant revision strategies have not focused on manipulating the soft tissue of the recipient site but have focused on selecting a prosthesis that will be better tolerated in it. The recent advances in fat grafting to the breast for augmentation and for reconstruction have initially sought to use fat for core volume replacement.1,2

Patients with excessive upper pole fullness and parenchymal thinning as late sequelae of saline implants may benefit from an alternative approach, namely, that of augmenting the overlying soft tissue of the subcutaneous space with fat grafting and simultaneously removing the prosthesis from the submuscular space. Simultaneous implant “exchange” with fat (SIEF) can also be used to address capsular contracture, implant malposition, and the aesthetic compromise of these conditions. There is probably no better situation to compare and contrast the principles and technical strategies of prosthetic implants to fat grafting than to analyze them in the same patient. In this manner, one can begin to appreciate the conceptual paradigm shift of using natural fat for volumetric augmentation and breast reshaping, and...
translate this from one’s experience using breast implants.

**CASE REPORT**

A 42-year-old G2P2 woman sought cosmetic improvement in the appearance of her breasts. Seven years earlier, she had undergone submuscular breast augmentation with 325-cc, smooth, round saline implants placed through the axilla. She complained of excessive upper-pole fullness that she felt was unnatural for her age. She was interested in having her implants removed but was concerned about what her breasts might appear like. Physical examination was notable for upper-pole fullness and excessive convexity on lateral view. The breasts demonstrated a 1-cm pinch of subcutaneous tissue. Examination suggested that adequate donor fat was available. The patient had no history of breast disease, no family history of breast cancer, and did not smoke. Results of a pretreatment baseline mammogram were negative.

**The Preexpansion Process**

The patient underwent baseline three-dimensional breast imaging (Axis 3, Inc., Boston, Mass.) to quantify total breast volumes. Her operative notes were obtained to determine the volume of her saline implants. By subtracting the implant volume from the total breast volume, a calculation of baseline natural breast volume was obtained. This volume was multiplied by 2.5, and was added back to the implant volume to establish a “goal” expansion volume.

The patient was fitted for an external expansion device (Brava, Inc., Miami, Florida) for external breast preexpansion and given a detailed expansion program. A vacuum pressure gauge was incorporated into the system that used a hand pump for suction, ranging from 1 to 3 inches of mercury. The patient was seen in the office over the following 2 weeks and underwent interim three-dimensional breast imaging to objectively measure the relative increase in breast volume. The device in this context was used to measure relative increases in breast volume. By interpolating between baseline volume and final goal volume, interval goal volumes were derived and compared with actual measured weekly volumes. If the patient met her interval goal volume, it served as positive reinforcement. If the patient failed to reach her interval goal volume, supportive dialogue ensued and necessary adjustments to the program were made. By 3 weeks, the patient successfully reached her goal volume (Fig. 1).

**Operative Strategy and Technique**

**Harvesting**

After infusing the abdomen, flanks, and thighs with 5 liters of a standard tumescent solution consisting of 30 cc of 1% lidocaine with epinephrine, 1:100,000 per liter of normal saline, a total of 2400 cc of aspirate was removed from the aforementioned areas using a 3.5-mm multihole blunt cannula attached by standard liposuction tubing to a sterile “in-line” collection canister placed on the operative field. A second set of tubing from this canister was connected off the sterile field to a standard liposuction unit (Berkeley Medevices, Inc., Richmond, Calif.) set at two-thirds of an atmosphere of constant vacuum pressure.

**Processing**

After collection, the aspirate was allowed to separate for 5 minutes at ambient gravity (1 g) and the crystalloid was tapped off from below using a “Keg Canister” (LipoSale, Inc., Farmingdale, N.Y.). What appeared as pure fat at 1 g was then drawn from the canister directly into standard 60-cc syringes. The fat in these 60-cc syringes was further processed on a side table, using a sterilized hand-cranked centrifuge, for 2 minutes. The centrifuge was turned at 1 to 1.5 cranks per second and had a 5:1 gear ratio and therefore spun at 300 to 450 rpm. Following the equation for relative centrifugal force...
force = (1.11824396 * 10^-5) * (r) × (rpm²), where r is the radius of the centrifuge (22 cm) and N is the rpm (300 to 450), a relative centrifugal force of 20 to 50 g was obtained. After low-speed centrifugation, additional crystalloid averaging 20 percent settled to the bottom of the syringes. Unwanted crystalloid was discarded before transplantation.

**Fat Transplantation**

**Phase I Injection: Injecting Fat over the Existing Implants That Are Left in Place**

With the implants still in place in the submuscular position, processed fat was injected using 60-cc syringes and a 14-gauge blunt sidehole needle into each breast subcutaneous space. Initial skin puncture was made using a 14-gauge needle at three or four sites, 1 cm inferior to the inframammary fold, because augmenting with fat, like implant augmentation, has a tendency to lower the fold. Care was taken to transplant the fat into the expanded breast subcutaneous space and to avoid injection into the breast parenchyma, the breast implant, or into the pocket of the breast implant. A “reverse liposuction” technique of injection, with gentle pressure on the 60-cc syringe, was used as described previously. Fat was injected completely over the implants and in the transitional zones immediately adjacent to the implants where the border of the prostheses met the chest wall.

As the fat was transplanted, the volume of the subcutaneous space increased progressively in thickness, making it technically easier to avoid entering the implant pocket or injuring the prosthesis. After a total of 300 cc of processed fat was injected into each breast, the implants were removed through their original transaxillary incisions. Care was taken to minimally dissect overlying breast subcutaneous tissue and to keep the subcutaneous space isolated from the implant access incision. After removal of the intact implants, the pocket was inspected to document that no fat had been inadvertently injected into the implant capsule. No attempt was made to perform a capsulotomy or capsulectomy or to place a drain in the implant pocket. The implant pocket collapsed under the overlying grafted breast, obliterating this space.

**Phase II Injection: Injecting Supplemental Fat after Implants Are Removed**

The removal of the implants resulted immediately in a collapse of the implant pocket onto the chest wall and caused a simultaneous lowering of the subcutaneous pressure of the breasts. This allowed the transplantation of an additional 325 to 330 cc of processed fat into the breast subcutaneous space on each side. At the end of the procedure, each of the implants was effectively exchanged for over 600 cc of fat, placed into the preexpanded breast subcutaneous space on each side.

The patient was followed up in the office. At 12 months postoperatively, photography, quantified by three-dimensional breast imaging, revealed that her breasts were similar in volume to when she had had breast implants (Fig. 2).

**DISCUSSION**

In published working classifications used as a guide to treat patients seeking breast augmentation, the degree of available native breast soft tissue and the importance of “tissue stretch” has been clearly articulated and emphasized. Following these principles, a patient seeking implant revision and presenting with excessive upper pole fullness, as is sometimes seen in saline breast augmentation, is routinely treated with bilateral implant exchange with silicone implants and when applicable pocket reassignment to a submuscular position. Patients with breast implants can also develop soft-tissue thinning in the long term because of chronic underlying pressure generated by an overfilled saline implant, age-related breast atrophy, or both.

This patient type, especially those with a lean body mass index, can be one of the most challenging to treat using simple implant exchange, because implant/soft-tissue disharmony is often not entirely attributable to excessively large implants, but because of an element of inadequate soft tissue. We define poor aesthetic results stemming from inadequate soft tissue overlying adequately functioning prostheses as “soft-tissue failure,” as opposed to implant failure. There are several factors that appear to be in conflict when using traditional implant exchange methods in these patients.

First, if inadequate soft tissue limits prosthetic size selection during original implant augmentation, during classic implant exchange there may be even less soft-tissue coverage than there was in the original procedure. Theoretically, this would mandate a smaller implant than the initial implant. Often, in practice, however, a larger implant is selected by the patient and the surgeon. This may lead to a cyclical process of soft-tissue thinning and may result in worsening “soft-tissue failure.”

Second, the spherical nature of breast prostheses—specifically, overfilled saline prostheses—imposes geometric limitations on selective or preferential volume placement and transitional fill. This often leads to excessive volume enhancement in regions of the breast where it is not needed or desired and, in thin patients, abrupt beginnings and ends of prosthetic volume with unnatural zones of transition.

Removing a breast implant in a patient who does not desire excessive upper pole fullness or who exhibits thinning of the overlying breast soft tissue involves a variety of options, including implant style change, pocket reassignment, the use of acellular dermal matrix, or permanent explantation. These strategies often attempt to improve breast aesthetics by abandoning the prior implant site. However, classic site change in some cases does not sufficiently address the unmet clinical need for additional soft-tissue coverage. It is rare for patients to abandon implants altogether. Often, these patients no longer desire to be as large as they are with the existing implant, but simply fear the deflated, ptotic, and aesthetic shape consequences of simple explantation.

Simultaneous implant exchange with fat represents an alternative approach, using a new, third...
Fig. 2. Anteroposterior and lateral (above) preoperative and (center) 12-month postoperative views of the patient in the case example following simultaneous implant exchange with fat. On three-dimensional imaging, the breasts had measured 480 cc preoperatively (below, left), consisting of 350 cc of saline and 130 cc of tissue. Postoperatively (below, right), breast volume was measured at 510 cc. Note the slightly larger volume, the adequate core projection, and the improvement in the upper pole excess convexity on lateral view after simultaneous implant exchange with fat.
space—the subcutaneous space of the breast. Autologous fat transplantation into the overlying breast subcutaneous tissue can reestablish soft-tissue volume sufficient to approximate overall preexchange breast volume. In addition, the preferential fill qualities of fat allow the use of simultaneous implant exchange with fat in excessively wide cleavage gaps (Fig. 3) and for breast asymmetry caused by bottoming out or capsular contracture (Fig. 4), and can be performed in conjunction with mastopexy (Figs. 5 and 6).

Revision of breast augmentation using stem cell–enriched fat after removal of implants has been reported. The technique used stem cells and digital insertion into the implant pocket to guide fat from being injected into the implant pocket. Average volumes of 254 to 264 cc per breast were injected and final volumes at 6 months averaged 157 to 150 cc, for a volume maintenance of 57 percent at 6 months.7

The currently reported technique of simultaneous implant exchange with fat mammogram differs in three fundamental ways:

1. Preexpansion: External volume expansion allows a larger space capacity, and soft-tissue

Fig. 3. Simultaneous implant exchange with fat for lateral drift and wide cleavage gap. (Above) Anteroposterior and lateral views of a 32-year-old patient who had 275-cc saline implants placed in the distant past and exhibited a wide cleavage gap and lateralization of her implants. Total breast volumes (implant and natural breast) by three-dimensional imaging averaged 341 cc. (Below) Anteroposterior and lateral views 1 year after simultaneous implant exchange with fat. Simultaneous implant exchange with fat allowed augmentation in the new, third space of the subcutaneous tissue of the breast, ignoring altogether the pocket problems on both sides. Note the shape change, better symmetry, and improved transitional fill medially. Total breast volumes 1 year postoperatively by three-dimensional imaging measured 410 cc.
stretch modulates the recipient-site microenvironment, by a negative-pressure effect similarly seen in open wound environments.\textsuperscript{8}

2. Phase I injection: Grafting over the existing implant allows for precise breast shaping and volume enhancement in critical areas and reduces the risk of injecting fat into the implant pocket, where it is less likely to survive. In addition, the lack of dependence on digital insertion into the breast implant pocket allows the implant to be removed through an axillary incision, without an unnecessary incision on the breast that limits fat transplantation in the immediate area because of the egress of fat.

3. Nonmanipulated fat: This allows the procedure to be performed in 2 hours or less and within the current societal and regulatory guidelines set forth by the American Society of Plastic Surgeons, the American Society for Aesthetic Plastic Surgery, and the U.S. Food and Drug Administration.\textsuperscript{9}

The preoperative strategy of external expansion and the intraoperative grafting strategy into the subcutaneous space with the implant left in place provides potential technical advantages. First, nonsurgical preexpansion of the breast over the underlying implant increases the potential soft-tissue space for the insertion of fat. This in turn may increase the overall volume of fat that can be safely injected into the breast parenchyma before reaching high interstitial pressures. Second, the implant, remaining in place during the first phase (phase I) of injection, provides a more rigid, stable platform, making aesthetic placement
of the fat more accurate and avoids undesired injection into the implant pocket. Once the subcutaneous space is partially filled (250 to 300 cc) and the implant is removed, there is a drop in subcutaneous tissue pressure, allowing additional fat to be injected, during the so-called phase II injection. Because the subcutaneous thickness was increased during the phase I injection, it is less likely to enter the implant pocket during the second phase of injection. Instead of subglandular or submuscular implants, fat transplantation to the breast subcutaneous space at the time of implant removal represents a new option for augmentation into the subcutaneous or third space of the breast (Fig. 7).

The subcutaneous space of the breast is completely independent and discontinuous from the underlying empty and abandoned implant pocket. New borders of the breast footprint can be created using preferential fill, independent of the underlying pocket, in accordance with chest width aesthetics without the limitations of soft-tissue coverage seen in prosthetic breast augmentations or revisions. Comparing breast implants with fat grafting in the same patient, some important distinctions emerge, as outlined in Table 1.

Commercially available external expansion devices are currently used off-label in core volume fat transplantation.\textsuperscript{10} In the current cases described, such devices were also used off-label. Although there is theoretical potential for a vacuum of one-tenth of an atmosphere (the maximum vacuum pressure used in these patients) to affect a breast implant, there is likely a significant drop-
off in any vacuum effect at all at the level of a submuscular breast prosthesis. Any damage to the implant either during expansion or during the time of the procedure would be observed as acute deflation; however, such findings were not observed. As the implant is destined to be removed in 2 weeks' time anyway, such potential implant damage is temporary and of little consequence.

**Fig. 6.** Representative pre–simultaneous implant exchange with fat mammogram (left) and 6-month postoperative mammogram (right) of patient shown in Figure 5. Report from pre–simultaneous implant exchange with fat mammogram read: “The previously noted 3- to 4-mm nodule in the inferior lateral peri-areolar region is stable from 1/24/09 and this nodule has a benign mammographic appearance. The previously noted 7-mm oval-shaped nodule at approximately the 12 o’clock position cannot be demonstrated on current exam. No architectural distortion or suspicious microcalcifications.” The 6-month post–simultaneous implant exchange with fat mammogram was read as: “Comparison is made to mammograms dated 1/2009-1/2010. There is moderate density (D2). There is some architectural distortion in both breasts consistent with removal of prior breast implants. No new dominant or suspicious mass is evident. There are no suspicious calcifications or skin changes. There are few benign appearing calcifications bilaterally. There is a small ovoid nodule in the retro-areolar region in the right breast which is stable. IMPRESSION: POST REMOVAL BREAST IMPLANTS. NO INTERVAL CHANGE TO SUGGEST MALIGNANCY.”

**Fig. 7.** The strategy of simultaneous implant exchange with fat and the third space of the breast. (Left) The implant-augmented breast. (Second from left) The augmented breast externally expanded with the Brava device. (Center) The expanded subcutaneous soft-tissue third space, seeded with fat over the implant (phase I injection). (Second from right) Once the implant is removed intraoperatively, the pressure in the third space decreases. (Right) Final breast size with fat is roughly equal to the preoperative volume with implants.
Translating Desired Volumetric Increases between Implants and the Fat-Grafted Breast

Barring rare device failure with leakage of silicone or saline, the excellent device record of implants combined with their inert nature assures the patient and the surgeon that the preoperative desired implant volume will yield the actual increase in breast volume postoperatively. In contrast, fat grafting for desired long-term volumes is not as predictable.

A fat-grafted breast is not an implant made of fat. The two procedures cannot be equated on a cubic centimeter–for–cubic centimeter basis. Such precision seen with prosthetic implants is not possible with fat transplantation for two main reasons: there is breast volumetric loss over time following grafting, and transitional border zone fill effects allow increased volumes of fat to be grafted. Previously published work using radiologic volumetric data analysis with fat grafting for cosmetic breast augmentation demonstrates a volume retention over 6 months of $64 \pm 11$ percent.\(^1\) Such loss of breast volume may be attributable to an element of apoptosis and cell death, a reduction in adipocyte volume after transplantation and survival, or a reduction in the fluid content of the grafted slurry. In reality, all three of these factors are likely to contribute to volume reduction over time. Because of the consistency of volume maintenance reflected by the standard deviation of 11 percent, a cornerstone of the translational strategy between achieving a desired volumetric result with fat therefore is to divide desired “implant” volume by 0.6, resulting in a larger volume of grafted fat to achieve a desired volumetric result.

Implant Volumes, Fat Volumes, and the Role of Transitional Fill

Besides presumed loss of graft volume over time, the ability to transition or “feather” volumes of fat along a potentially wider breast footprint is a second reason it is not possible to equate fat injection volumes with breast implant volumes. The versatility of microlobular fat grafting means an increased ability to place volumes of fat in transitional zones. In submuscular implants, the superior buffer of the pectoralis muscle places less demand for transitional fat in this area. Inferiorly, an abrupt contour change is desired at the inframammary fold; therefore, there is little need for transitional fat in this location. The added transitional fill opportunities with fat transplantation to the breast are predominately medially and laterally localized on the breast footprint and along the tail of Spence. The tail of Spence and its transition to the lateral chest wall is a historically undermanaged aesthetic region of the breast in a treatment variety of flaps, expanders, and implants. Adding the versatility of fat opens up new possibilities for breast shaping in these areas. Considering both these factors, a 64 percent volume reduction in grafted fat over time and the increased ability to transplant more fat into transitional zones, the author currently uses a 2:1 ratio of fat transplantation to desired classic implant size increase.

CONCLUSIONS

The advent of simultaneous implant exchange with fat (SIEF) provides adequate volume maintenance and is a viable option for that subset of breast augmentation patients seeking removal of their implants. A technical comparative analysis of implants and fat reveals they both have inherent advantages and disadvantages. In some categories, these advantages and disadvantages can complement one another. If the current debate is implants versus fat, the versatility of fat and the core volume reliability of implants may, in the future, evolve to a place where implants and fat can work together, serving essential functions in the same patient.

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It makes sense that randomized, controlled, blinded, multicenter trials with hundreds or thousands of patients and years of follow-up would have a higher level of evidence than a single author’s experience in a clinical series. However, given the demands of such studies, it also makes sense that there would be few randomized controlled trials but many single-author series or expert opinions. Such series and expert opinions do have value. PRS welcomes the submission of such papers and will continue to publish them.