

Primary Breast Augmentation with Fat Grafting



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KEYWORDS

- Breast augmentation • Fat grafting • Autologous fat transplantation • Fat injection • Fat transfer
- Adipose-derived stem cells

KEY POINTS

- Fat grafting to breasts is a good choice for breast augmentation.
- Autologous fat transfer avoids foreign body reaction or capsular contracture, which potentially complicates the implant-based breast augmentation.
- Meticulous fat graft harvesting, processing, and injection is the key to a successful result in the mega-volume fat grafting.
- Pregrafting skin expansion is necessary for patients with tight breast skin tissue.
- Postoperative care with immobilization of the graft is imperative for a satisfactory outcome.

INTRODUCTION

There has been a renewal of interest in the fat grafting to breasts recently. Reasons for revisiting of these techniques are its advantages over implant-based breast augmentation, including avoidance of foreign body with implants and its associated complications such as capsular contracture and malposition deformity. Initially, the safety and efficacy of fat grafting to the breasts had been questioned mainly due to the issues of low graft survival percentage and its associated complications. The statement from the American Society of Plastic Surgery Fat Grafting Task Force in 2009 suggested that fat grafting may be indicated for breast augmentation and reconstruction.¹ Emerging reports in the literature have also echoed the safety and efficacy of fat grafting to breasts because the postoperative incidence of malignancy is not increased^{2,3} and the limited

data regarding the radiologic impact of fat grafting to breasts suggest that there is little interference with breast cancer screening.⁴

The technique for fat grafting should be performed in 3 stages: harvesting of adipose tissue from proper donor sites, processing of lipoaspirate to remove impure nonfat tissues, and meticulous reinjection of the purified fat grafts to ensure an even distribution of the grafts in the breasts. Proper patient selection is the key to achieving a superior outcome of primary fat grafting for breast augmentation, specifically referring to the need for a special consideration to the skin pliability and stretching ability of the patient's chest skin. In this article, the authors share their established and rationalized techniques of fat grafting for primary breast augmentation and propose an algorithmic approach to fat necrosis after fat grafting for breast augmentation as a way of managing complications.

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INDICATIONS AND CONTRAINDICATIONS

Patients who have abundant adipose tissues as the donor site for harvest and pliable skin pocket and sufficient tissue dimension that serves as a good recipient base for injection of adequate volume of graft will be well indicated for breast augmentation with fat grafting. The patient who expects a volume of 120 to 150 cc increase is also a good candidate because this procedure has limitation in the increment of breast size in one session of fat grafting. There is no absolute contraindication for this procedure. However, patients who do not have sufficient adipose tissues to be harvested and those who have deficient breast skin envelopes and disagree to undergo either internal or external tissue expansion when necessary are not good candidates for this procedure.

PREOPERATIVE EVALUATION AND SPECIAL CONSIDERATIONS

Patients with a higher risk of breast cancer should be well informed that long-term safety issue of fat grafting to breasts in patients of this category has not been fully investigated. Therefore, it is suggested that patients with a higher risk of breast malignancy not have fat grafting to breasts unless they are willing to pay an additional attention and effort in breast cancer surveillance after the operation. Fat necrosis can develop in the form of solid tumors and calcification that potentially complicates breast cancer screening.

The volume of available fat is important for preliminary assessment of the volume to be harvested for single or multiple sessions of fat grafting depending upon patient's expectation. Estimation of the volume of body fat is conveniently achieved by palm measurement in which one palm size is about 180 to 200 cm² depending on the surgeon's palm size.⁵ The thickness of fat tissue is tested by a pinch test. The volume of fat to be collected is calculated by the product of the estimated surface area and thickness of fat to be suctioned (volume = palm size 200 cm² × thickness of fat to be suctioned). In general, a total of 700 to 800 mL of lipoaspirates (not including the inframammary fold distance) can be harvested from both thighs and is enough for most patients.

A special attention should be paid to the breast skin tightness or constricted breast. The skin tightness can be tested by stretching and pulling breast skin off the body with how much effort and strength. Patients with a short nipple to inframammary fold distance may serve as a sign of tight lower pole skin. Note especially that

expansion of the skin dimension in the lower pole is an indispensable part for achieving an esthetic breast contour in tight breast skin envelope. In addition to the ideal contour of breast shape, patients who desire an increment of more than 2 breast cup size should be informed of the necessity of multiple sessions of grafting.

SURGICAL PROCEDURES

Favorable donor sites include areas that uniformly have abundant or excess adipose tissues to be harvested such as abdomen, flanks, buttocks, medial and lateral thighs, or knees. Generally, donor sites are selected where body contouring with liposuction is easily accessible in the supine position. Although viability of adipocytes within the fat grafts from different donor sites has been reported to be equal, higher cell concentration of lipoaspirates is found in the lower abdomen and inner thigh⁶ in the young (21–37 years old) female group (**Fig. 1**). They are also better donor sites of adult mesenchymal stem cells and therefore should be chosen as the “preferred” donor sites for fat transplantation.⁷

Fat Graft Harvesting

The surgical procedure is normally performed under general anesthesia, or intravenous sedation. The tumescent solution used for donor site analgesia or hemostasis should contain lidocaine that synergizes with general anesthesia. However, we suggest that lidocaine concentration be kept to a minimum because lidocaine toxicity is detrimental to adipocyte function and viability.⁸ Generally, we use 0.01% lidocaine in Ringer's lactate if performed under general anesthesia. The tumescent solution contains epinephrine with a concentration of 1:200,000. Vasoconstriction effect from



Fig. 1. Liposuction for harvest of fat graft from lower abdomen and inner thighs as the preferred donor sites.



Fig. 2. Centrifugation of the lipoaspirate in the 50 mL syringes with 3000 rpm (1200g) for 3 minutes.

epinephrine promotes hemostasis and reduces the risk of intra-arterial injection of the fat graft.

A 4-mm incision is made for infiltration of tumescent solution and for graft harvest with a No. 11 blade in the locations where the scar can be hidden in the groin crease with clothing. The tumescent solution is then infiltrated evenly to the donor site 10 to 15 minutes before fat extraction, which makes harvesting of fat graft easier and less traumatic. The ratio of aspirated fat to tumescent solution volume is about 1:1. The suction power for suction-assisted lipectomy using the machine was set to a negative pressure as low as 70 mm Hg. Lipoaspirates are collected into a 2 L or 3 L canister, which has a draining hose attached to its bottom. The watery part at the bottom of the canister is drained out after lipoaspirate is set standstill for a while by gravity. The fat portion in the lipoaspirates is then collected through the hose connection into syringes of the volume size of the surgeon's preference for convenience of centrifugation.

Fat Graft Processing

The authors choose a 50 mL Luer-Lok syringe for more efficient fat graft processing in mega-



Fig. 3. Centrifuged lipoaspirate layers in 3 parts: oil (top), centrifuged fat (middle), and water part (bottom).



Fig. 4. Transfer of centrifuged fat graft from 50 mL syringe to 10 mL syringe for better control of injection.

volume fat grafting. The fat portion of the lipoaspirates can be easily transferred to a 50 mL Luer-Lok syringe, which is snugly attached to the flexible hose that drains out the lipoaspirates. The Luer-Lok aperture of the syringe is then locked with a plug. After careful removal of the plunger, all lipoaspirate-filled syringes are then centrifuged with 3000 rpm (about 1200g) for 3 minutes as advocated by Coleman (**Fig. 2**). Centrifugation with a greater g force or longer duration may be harmful to adipocytes and is therefore not recommended.⁹

In authors' experience, centrifuged lipoaspirates can be concentrated into 60% of its original



Fig. 5. Fat graft is injected through a 3 to 4 mm incision in the inferior or lateral inframammary fold or around the areola border. Fat graft is injected into all layers (subcutaneous tissue, breast parenchyma, and above, inside, and under pectoralis muscle) of breast tissue and fanned out in a radial fashion to achieve an even distribution of graft in the breast tissue.

volume. Therefore, an estimated 700 to 900 cc lip-oaspirate is needed for conversion into 400 to 600 mL of concentrated fat for injection after centrifugation. Every effort should be made to stick to the “no touch” principle in which fat graft exposure to air should be kept to a minimum to avoid graft contamination. After centrifugation, lip-oaspirates in the syringe are divided into 3 layers: the oil content in the upper layer, fatty tissue in the middle layer, and the watery portion at the bottom (**Fig. 3**). The oil can be decanted from the syringe. The residual oil is wicked with a cotton strip or swab. The fluid at the bottom can be easily drained out once the plug at the Luer-Lok aperture is removed. The concentrated fat in the 50 mL syringe can then be transferred to a 10 mL syringe (our preferred size of syringe for fat injection in primary fat grafting to breasts; **Fig. 4**). Pay attention to the air bubbles inside the syringe and they should be removed and thus quantification of the volume injected can be precise.

Placement of Fat Grafts

Injection of fat graft to the breast requires an understanding the relevant anatomy in this area for safety and efficacy of this operation. The key to a successful fat graft injection is to achieve an even distribution of fat grafts in the recipient site. A 15-cm 12-gauge cannula is attached to a 10 mL syringe containing the fat graft, which is then slowly injected into the breast and fanned out in a radial fashion through a 3 to 4 mm incision. Fat graft is injected in small amounts as the cannula is withdrawn; we use multiple passes, with multiple tunnels, and within multiple tissue planes. Specifically, small aliquot of graft (0.5 mL) should be injected while withdrawing the cannula for a distance of at least 12 to 15 cm. One practical

way to avoid repeated injection at the same spot is that the resistance is always felt during the advancement of the cannula into the virgin tissue before graft injected. Topographically, fat graft is injected into the subcutaneous layer, inside or behind the breast parenchyma, inside the pectoralis muscle (the proximal part of muscle), and behind the muscle as if the graft is totally infiltrated into the breast tissue. The choices of incision location include the inferior and lateral positions near the inframammary fold and around the border of nipple areolar complex where scars can be easily hidden (**Fig. 5**). Injection should be as gentle as possible to avoid a possible injury to vessel or nerve. Advancement of the cannula with too much force would compromise vascularity of the recipient tissue that is important to nourish the graft and increases the chance of complications. The end point of fat injection is based on the tension across the skin pocket due to filling of the fat graft as judged by the operating surgeon. In general, the injection volume of concentrated fat is between 150 and 250 mL for each side of breast depending on the patient’s original breast tissue volume. Deeper to the subpectoral level lies the rib cages and intercostal muscles and thus injection should not point downward toward the thorax once the cannula is deep to subpectoral level because pneumothorax may occur once cannula penetrates the pleura.

Preexpansion of tight breast skin pocket

Tissue expansion can be external vacuum expansion (EVE) or internal expansion with implant placement. EVE such as Brava system is to create a continued negative pressure on the breast skin mounted by a dome-shaped device. Successful application of EVE requires attentive education to

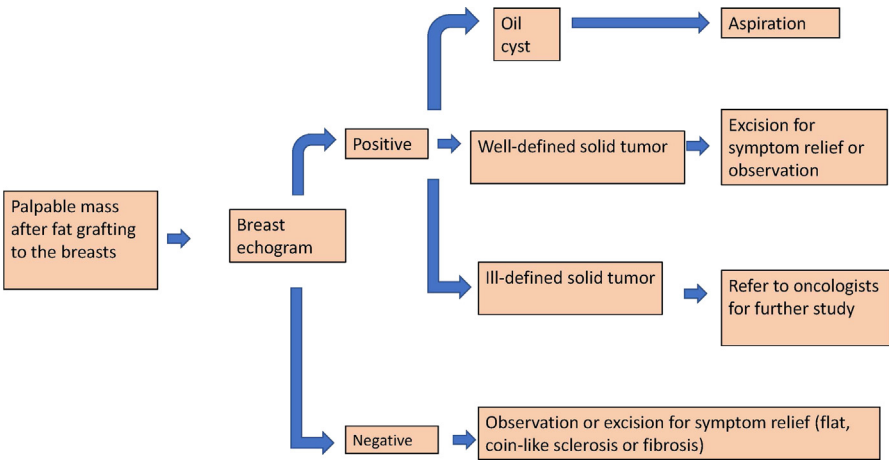


Fig. 6. The algorithm proposed for approach of fat necrosis following fat grafting to the breasts.

the patients and strict patients' compliance. Therefore, the authors preferred implant or tissue expander for internal expansion, which provides a stable and reliable expansion of the breast skin pocket especially at the lower pole of the breast. The implant/tissue expander is placed subpectorally to achieve an esthetically larger breast mound, and this procedure is no different from implant-based breast augmentation surgery. The implant/tissue expander expansion can be effective in as short as 1 to 2 months after implantation. Surgeons should avoid injection into the capsule cavity left after implant explantation because fat grafts in the cavity will not survive and fat necrosis will develop eventually. Fat graft should be injected to the areas anterior to the anterior wall of the

capsule. If unfortunately capsular contracture develops, then capsulotomy or capsulectomy should be done to release the contracture holding skin from expanding to a good contour. Capsulotomy was performed for Grade 1-2 capsular contracture and partial capsulectomy on the anterior wall for Grade 3-4 capsular contracture to ensure an adequate expansion of subcutaneous skin pocket for maximum lipofilling, especially in the lower pole of the breast.

POSTOPERATIVE CARE AND EXPECTED OUTCOME

Patients are instructed not to exercise strenuously using pectoralis major muscles in the first 3 months



Fig. 7. Comparison of the preoperative original photos, 12 months after first and second sessions of fat grafting to the breasts. The first and second sessions of fat grafting are 12 months apart. The volume of first session grafting is 210 cc on each side breast. The volume of second session is 190 cc on each side.

following the surgery. It is also imperative that patients not have hard compression or tight clothing on the breasts for the same period postoperatively. The rationale is that mobility and tight compression on the graft recipient site may violate neovascularization to the fat grafts. Swelling in the recipient site is expected for 1 or 2 weeks. The long-term fat graft retention rate has been reported with variable success in the literature.^{10,11} Based on our experience, about 60% (or about 110–130 mL) of the long-term graft volume retention rate can be achieved.¹²

MANAGEMENT OF COMPLICATIONS

Serious complications such as pneumothorax at graft injection or breast tissue infection is very rare. Meticulous injection and awareness of the direction of the cannula tip can avoid inadvertent pulmonary puncturing. Aggressive antibiotic treatment pending bacteria culture is necessary and serial debridement and adequate drainage are imperative for salvage if infection develops.

The most commonly seen complication of fat grafting to the breasts is fat necrosis.



Fig. 8. Comparisons of original preoperative photos and the first and second postoperative photos are done and demonstrate the satisfactory outcomes both at 5 years of follow-up. The first and second sessions of fat grafting to the breast are 5 years apart. The first and second session of fat grafting volume for both side breasts were 220 and 200 cc, respectively.

Nonabsorbed necrotic fat in the form of oily cyst, sclerotic induration, and calcified solid tumor may cause palpability, pain on palpation, skin retraction, dermatitis, and postinflammatory hyperpigmentation. Although there has been no scientific data showing that fat necrosis-related tumors and calcifications can interfere with breast cancer screening, they may potentially complicate breast health check-up. Therefore, complications from fat necrosis in the breast should be managed promptly and properly. We suggest that any palpable mass noticed postoperatively should have breast imaging study such as breast echogram, which is noninvasive and

relatively quick to perform as a screening tool.¹² Oily cyst located superficially can simply aspirated using syringe with an 18-gauge needle. Hard fibrotic or calcified nodules can be excised through a stab incision directly above the lesion site or mammotome that is used for core needle breast biopsy. In the author's practice, we manage fat necrosis through an algorithm using a mammotome (**Fig. 6**).

REVISION OR SUBSEQUENT PROCEDURES

Once the final result (with a waiting period of 4–6 months) has achieved, the need for subsequent



Fig. 9. Comparison photos of preoperative breasts (*upper row*), breast augmentation with 300 mL silicone gel implants (*middle*), and implant explantation with simultaneous fat grafting to the breasts (*bottom*). Skin expansion with breast implant augmentation lasts for 1 year before explantation and immediate injection with 230 mL of fat graft to the breasts.

revision to improve the breast contour is rare. However, patient may need a repeated injection for further augmentation. There is no scientific study, which has addressed the timing of subsequent fat grafting. It is difficult to assess the surgical outcome at the initial stage following the operation. In general, we have observed the transplanted fat gradually loses its volume with time and usually becomes stabilized at 4 to 6 months postoperatively. Therefore, the timing of a subsequent fat grafting procedure should be deferred to at least 3 to 4 months after the previous transplantation. In addition, patients should be informed that the result of the breast volume is still subject to change in accordance with the body weight change even when the outcome is finalized.

CASE DEMONSTRATION

Case 1

A 30-year-old woman had undergone 2 times of fat grafting to her bilateral breasts for augmentation. Her breast skin tissue is soft, and pliable when stretched. The volume of first session grafting is 210 cc on each side breast. The volume of second session is 190 cc on each side. Comparison photos of original and the first and second grafting to the breasts are shown (Fig. 7). The patient is satisfied with the surgical results with no complications.

Case 2

This 35-year-old woman received fat grafting for bilateral breast augmentation twice. Her breast



Fig. 10. Preoperative and postoperative photos of breast augmentation with 330 mL gel implants are shown.

skin envelope is elastic and pliable during stretching. Comparisons of original preoperative photos and the first and second postoperative photos are done and demonstrate the satisfactory outcomes in long-term follow-up (**Fig. 8**).

Case 3

This 25-year-old woman requests fat grafting for breast augmentation and wishes to have 2 to 3 breast cup size increase. Her original breast skin tissue is tight and therefore pregrafting tissue expansion is planned. Breast augmentation with 300 cc silicone gel implants was done. Explantation was done 1 year later and immediate fat grafting was performed with injection volume of 230 cc to the bilateral side breasts. A satisfactory result is

shown 6 months after breast implant explantation and simultaneous fat grafting (**Fig. 9**).

Case 4

Breast augmentation with the implant of 330 mL (**Fig. 10**) through transaxillary approach was planned in this 22-year-old woman as the method of preexpansion of breast skin before fat grafting to the breasts. Two sessions of fat grafting to the breasts were done after explantation. The first session of fat grafting of 200 mL was done immediately in each side breast after explantation. The second session of fat grafting of 210 mL in each breast was done 4 years following the first grafting. Comparison of postoperative photos of first and second session of fat grafting are shown



Fig. 11. Comparison of postoperative photos 4 years after the first session of fat grafting (200 mL) and 1 year after the second session of fat grafting (210 mL) are shown.

(Fig. 11). Comparing photos of the original breasts and after the second session of fat grafting are also shown (Fig. 12).

DISCUSSION

Surgical techniques are important to a successful result in primary breast augmentation with fat grafting. Delicate graft harvesting, refinement of graft processing to provide pure parcels of adipose tissue with integrity and meticulous reinjection of adipose tissue to the recipient sites are all equally essential for the long-term fat graft retention. We prefer to use 4 mm cannula for harvesting. Harvesting cannulas with a larger caliber are managed to collect larger adipose parcels and

have been shown to improve adipocyte viability and long-term graft survival.¹³ This can be accounted for by the fact that larger caliber cannulas lead to less shearing force and less traumatic to adipocytes during procurement. Higher viability of adipocytes with 4 mm cannulas was demonstrated compared with 2 and 3 mm cannulas in a randomized prospective study reported by Ozsoy and colleagues.¹⁴

Despite the literature has thus far failed to reveal a single superior method for fat graft processing, centrifugation is perhaps the most recognized technique for processing and has been considered the standard. In order to effectively remove the impure materials, including the excess infiltration solution, hematogenous cells, free oil, and the



Fig. 12. Preoperative and postoperative photos comparing the original breasts and the final outcome (1 year after the second session of fat grafting) are also shown.

nonfat elements within the lipoaspirates and to obtain more concentrated fat grafts. Not only do these nonfat elements cause inflammation that can be harmful to the fat graft but also injection of debris gives an illusion of adequate volume correction. Moreover, centrifugation separates adipocytes from the substances that may degrade them such as blood cells, proteases, and lipases. In addition, recent studies have shown that proper centrifugation can concentrate not only adipocytes and adipose-derived stem cells (ADSCs) but also several angiogenic growth factors such as fibroblast growth factor and vascular endothelial growth factor within the processed fat grafts.¹⁵ Maximizing the number ratio of ADSCs to the graft promotes the graft survival have been reported by many authors in the literature.¹⁶ However, the exact benefits of ADSC for graft survival and the optimum ratio of ADSC to adipocyte have been elusive and contradictory results of ADSC-assisted lipotransfer have been reported⁴ and thus a larger scale of clinical trials is needed.

The principle of reimplantation of fat grafts is based on optimizing recipient site vascularity for increased graft survival.¹⁷ Graft through nutrition by tissue fluid absorption can survive up to 48 hours, whereas the neovascularization proceeds with the rate of 1 mm per day. Therefore, ideally, the diameter of graft parcel should not exceed the diameter of 2 mm to avoid central necrosis.^{5,18} Following this science rationale, 1 mL of fat graft should spread across a path of at least 25 to 30 cm in length when injected as a microcylinder with a diameter of 2 mm or 0.5 mL of graft over a path at least 12 to 15 cm in length.

Overcorrection for “better” graft survival in the recipient site seems to be lack of scientific support. Excessive overcorrection, which increases the complications of fat necrosis and infection especially for breast augmentation that proceeds with mega-quantity fat injection, is not recommended.

SUMMARY

Breast augmentation with primary fat grafting offers an option for breast augmentation and is a procedure that requires a comprehensive understanding of the science of autologous fat transplantation. The surgeon should master the techniques of liposuction and fat injection using the appropriate instruments. Moreover, proper patient selection is also important for a successful outcome. The surgeon should stick to all the principles that have been described here to ensure a satisfactory result.

CLINICS CARE POINTS

- Evaluation of the appropriate candidate for fat grafting to the breasts is a critical step for an optimal result, including the availability of fat graft harvest, and pliability of breast skin envelope.
- Meticulous graft injection following the principle of multiple planes and multiple tunnel and avoidance of over grafting is the key to a successful result and reduction of complications.
- Preexpansion of breast skin and tissue is an important step for achieving an esthetic breast shape and larger volume of graft retention before fat grafting to the breasts in patients with constricted breasts or tight breast skin envelopes.

DISCLOSURE

The authors have nothing to declare regarding the products, drugs, or devices mentioned in this article.

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