Application of Fat Grafting in Cosmetic Breast Surgery

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Abstract

Keywords

- fat graft
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- cosmetic breast surgery

The role of fat grafting to the breasts has evolved in the recent past, gaining several new applications within both reconstructive and aesthetic surgery. Initially used for reconstructive purposes to fill lumpectomy defects or to correct residual contour deformities after breast reconstruction, it has since made its way into cosmetic breast surgery and has grown to encompass a wide variety of new indications. Fat grafting in aesthetic breast surgery may be performed as a form of primary autologous breast augmentation or as an adjunct to implant-based breast augmentation to disguise implant edges. It may also be used to provide added volume after explant surgery or to provide improvements in breast contour alongside mastopexy techniques. In this article, we will review the current applications of fat grafting in aesthetic breast surgery and provide an up-to-date summary of its reported outcomes, safety, and complications.

Recent trends in both reconstructive and cosmetic breast surgeries reflect the high level of importance placed on breast cosmesis. Since 2000, there has been more than a 29% increase in the number of annual breast reconstruction procedures and a 48% increase in the number of annual augmentation mammoplasty procedures performed; cosmetic breast procedures alone make up nearly 25% of all cosmetic surgical procedures performed each year.¹ Despite the increase in the number of procedures, new techniques for cosmetic breast surgery have been slow to evolve. Fat grafting has emerged as a unique exception and has the potential to improve patient satisfaction and overall aesthetic outcomes.²

Fat grafting has emerged as a modality capable of addressing many of the limitations in techniques used in breast surgery. A 2013 survey study investigating trends in autologous fat grafting to the breast found that 62% of surgeons are using fat grafting in the setting of breast reconstruction and that 28% of surgeons are using fat grafting in the setting of aesthetic breast surgery.³ Reconstructive indications for fat grafting to the breast include its use as an adjunct to implant-based and autologous breast reconstruction, restoring contour deformities following breast-conserving partial mastectomy

and treating radiation injury deformities, and even its use for complete breast restoration following mastectomy.⁴ Cosmetic indications for fat grafting to the breast include primary breast augmentation without the need for a prosthetic device, volume restoration following implant removal, and concomitant injection alongside breast implant placement to disguise rippling and address visible step-offs that can sometimes be seen in thin patients or in patients with subglandular implant placement.⁴

The existing literature describes a wide variety of techniques for fat grafting to the breast. Intraoperative approaches have been reported to vary with surgeon preference, and technological advances are pushing the boundaries of aesthetic changes possible with fat grafting.^{5–8} There also remains some contention regarding the oncological safety of injecting actively signaling adipose cells with high regenerative potential into the breast, especially in patients with a personal or family history of breast cancer.^{9–12} Overall, fat grafting to the breast for cosmetic purposes appears to be a generally safe, increasingly popular procedure with high levels of patient satisfaction that needs further investigation regarding technique and associated risk.^{5–8} The aim of this review article is to provide an updated,

thorough summary of contemporary applications of fat grafting in aesthetic breast surgery.

History

The first-ever reported case of fat grafting to the breast was cosmetic in nature—in 1895, Czerny used a large buttock lipoma to reconstruct a postmastectomy defect.¹³ In 1912, Holländer first described actual injection of adipose tissue to the breast, showing its ability to both correct contour deformities and improve scarring.¹⁴ With the advent of liposuction in the mid-1980s by Fournier, the possibility of obtaining large amounts of semiliquid adipose tissue became reality.^{13,15} However, a 1987 statement issued by the American Society of Plastic Surgeons condemning the practice of fat grafting to the breasts out of fear for potentially obscuring the detection of breast cancer prevented this technology from being applied to the realm of cosmetic breast surgery for several years.^{4,16} With the publication of several studies that found no radiological or oncological contraindications to fat grafting to the breasts, the American Society of Plastic Surgeons revised their previous statement in 2009, conceding that autologous lipotransfer to the breasts could be considered for several indications.¹⁷ Since this landmark paradigm shift, fat grafting has come to be used in a variety of applications unique to cosmetic breast surgery.

Preoperative Assessment

Prior to performing autologous fat grafting, it is crucial to carefully evaluate a patient's past medical history, social history, and current health status. Key information that must be obtained includes patient age, smoking history, additional comorbidities, surgical history, bleeding history, and, if relevant, breast cancer and radiation exposure history and personal or family history of breast cancer. Preoperative planning should involve an in-depth discussion of the patient's goals for the operation. Physical examination should include standard bilateral breast measurements and an assessment of symmetry and skin quality, as well as evaluation of defect size and characteristics if one exists. Inspection of all donor areas for fat grafting is also important to predict the degree of correction with autologous augmentation. In terms of imaging, some surgeons mandate that their patients undergo either a preoperative mammogram or breast MRI (magnetic resonance imaging) to both obtain a clear understanding of the patient's breast anatomy and to establish a baseline for later comparison and to rule out any existing underlying pathology.^{4,18,19} Standard breast cancer screening guidelines should be followed before performing any breast procedure.²⁰ Crucial preoperative laboratory studies include a complete blood count, coagulation studies, and an ECG (electrocardiogram) in any patient over the age of 40 years.^{4,18}

During the initial consultation visit, setting realistic expectations for patients with regard to their perioperative course and postoperative outcomes becomes crucial. This includes informing the patient that multiple fat grafting sessions may be necessary to achieve their desired size. The authors have

found that to achieve a safe and aesthetically pleasing result, fat grafting is expected to produce no more than a one-cup breast size increase per session.⁴ As fat graft take is generally cited to be anywhere between 50 and 80%, fat resorption patterns cannot be predicted, and thus patients must be counseled regarding asymmetries or contour irregularities that could potentially arise from uneven fat resorption.⁵ Lastly, patients must be aware that although the rate of breast cancer in patients with fat grafting to the breasts is equivalent to that of the general population, fat grafting is associated with a higher rate of biopsies when palpable lumps are encountered despite the capacity for radiographic images to differentiate between fat necrosis and breast cancer.^{21,22}

Surgical Technique

The basic fat grafting procedure is composed of three steps: adipose tissue harvesting, processing of harvested adipocytes, and injection of processed adipose tissue at the recipient site(s). We will provide an overview of these steps in the next sections; however, the details of these techniques are beyond the scope of this article.

Fat Harvesting

The most commonly used strategies for harvesting adipose tissue include syringe aspiration, vacuum aspiration, and surgical excision from an adequate donor site.¹⁸ Depending on the fat storage distribution of each individual patient and the volume of adipose tissue required, fat can be harvested from many different areas of the body, most commonly the abdomen, flanks, and thighs.^{23,24} Several devices exist for harvesting adipose tissue; however, regardless of the device used, the most crucial objective is to minimize trauma to the grafted adipocytes. Careful handling has been shown to maximize adipocyte survival and to increase graft take.^{25,26} To this end, contemporary grafting techniques use large-bore cannulas and either manual extraction or low-pressure vacuum systems.^{25,27} The most commonly described method of fat harvesting was described by Coleman and entails the manual extraction of adipose tissue with a 3-mm, blunt-edged, two-hole cannula connected to a 10-mL syringe.²⁸

Purification and Processing

Centrifugation, filtration, and washing are all methods of purifying and processing harvested adipose tissue to separate healthy fat cells from surrounding blood and cellular debris.¹⁸ Coleman has written extensively on fat processing by centrifugation. The generally recommended specifications include centrifugation at 3,000 rotations per minute for 3 minutes to separate the aspirate into three layers. The top layer contains oil, the middle layer consists of the adipose tissue that will be used for grafting, and the bottom layer is composed of blood, anesthetic, and cellular debris.^{4,28,29} While the oil layer may be used to lubricate recipient sites, the lower layer is discarded.⁴ The authors prefer the filtration technique with simultaneous washing using a closed system for fat graft processing. This minimizes exposure of the fat to air, thus preventing desiccation and fat cell lysis. Many clinicians apply quick mechanical

processing techniques of the harvested fat through two interconnected small-diameter syringes (shuffling) to facilitate injection of the fat into the recipient site. This technique can be performed safely without altering tissue viability or the microscopic structure of the graft.³⁰

Fat Application

Coleman and Saboeiro describe fat application using a blunt, 17-gauge infiltration needle between 9 and 15 cm in length.⁴ The processed fat should be injected at various levels and in varying total quantities within the recipient site, depending on the reconstructive and/or aesthetic needs of the patient. Each injection must only contain a small volume to promote the diffusion of nutrients into the graft during the early stages of graft integration. This also increases the likelihood of revascularization and decreases the risk of deformities and lumps that can lead to fat necrosis and calcification.³¹ Application of grafted fat to the breast may be performed directly into the pectoralis muscle or into the breast parenchyma to enhance overall breast volume and projection or more superficially to address specific contour deformities and influence local breast shape.⁴

Applications of Fat Grafting in Aesthetic Breast Surgery

Within the field of aesthetic breast surgery, fat grafting has several applications. Cleavage appearance can be improved through fat grafting to the medial chest, which decreases the intermammary distance.³² In the setting of tuberous breast deformity, fat grafting can also be used unilaterally in cases of

significant breast asymmetry to add volume to the underdeveloped breast.³³ As in other body areas, fat grafting to the breast can also be used to fill contour defects.

Recently, one of the most popular applications of fat grafting in aesthetic breast surgery has been the use of autologous fat transfer that can also be performed independently as a means of primary breast augmentation.^{4,22,34,35} Benefits of this method include creating a natural appearance and feel to the breasts without the added risks associated with implant-based breast augmentation such as the development of capsular contracture, possibility of implant rupture, or need for implant exchanges.

Following implant-based breast augmentation, fat grafting can be a great addition to blend and camouflage the implant borders, thus helping to achieve a more natural transition from native tissue to the augmented breast, especially in subglandular breast augmentation and in patients with thin skin.^{36–39} On the other hand, for patients desiring removal of their breast implants, fat grafting can help restore some of the volume lost (►Fig. 1).⁴⁰

Similarly, fat grafting has been reported as an adjunct therapy performed concomitantly with other common breast surgeries, including mastopexy and reduction mammoplasty, to enhance aesthetic results and overall patient satisfaction following these procedures.^{41–44}

Cosmetic Applications of Fat Grafting in the Reconstructive Surgery of the Breast and Chest

Several aesthetic applications of fat grafting to the breast occur in the setting of breast reconstruction. Fat grafting has been

Fig. 1 Images showing a 50-year-old patient who desired implant removal. After each implant was removed, this patient underwent 150 mL of fat grafting to each breast for volume restoration. Postoperative photographs were taken at this patient's 1-month follow-up appointment; she is very happy with the results.

reported as successfully filling lumpectomy defects in a delayed fashion, and in patients with a history of radiation damage, the regenerative properties of adipose-derived mesenchymal stem cells (ASCs) can reverse radiation damage.⁴⁵ After implant-based or autologous breast reconstruction for total mastectomy defects, fat grafting can be used to correct residual contour deformities during revision surgeries.⁴

Beyond the setting of breast reconstruction, fat grafting to the chest has been reported in additional surgical reconstructive cases. Sternal defects have been reported to be effectively hidden with fat grafting,⁴⁶ and in cases of pectus excavatum reconstruction, fat grafting has been used to fill and level contour deformities.⁴⁷

Large-Volume Grafting and Volume Maintenance

Historically, fat grafting to the breast has been limited by maximal transfer volumes. To minimize fat necrosis and optimize graft take and graft survival, it had been noted that each stage of traditional fat grafting should be limited to 200 mL of fat transferred.⁴⁸ With the advent of the external tissue expander, however, this upper limit has been pushed much high in recent years. Using a device such as the Brava (Brava LLC) to apply external suction forces to the breasts for 3 to 4 weeks preoperatively and 2 weeks postoperatively, several studies have found that the recipient tissue increases its vascularity, which improves blood supply to grafted fat and increases graft take.^{48–50} With graft volumes as high as 300 mL per breast in a single operation, the use of perioperative external expansion has been shown to have higher graft survival rates, up to 70 to 80%, increasing the efficiency of autologous fat grafting for both reconstructive and aesthetic goals.^{48,50}

Postoperative Care

Postoperatively, it is crucial to minimize sheer forces on the breasts to allow for inosculation and revascularization of the grafted adipocytes. Typically, surgical brassieres are given to patients to provide protection without placing excess compression on the healing tissues.⁴ Some surgeons have described the use of transparent adhesive dressings over fat graft sites on the breasts. In addition, some external tissue expansion protocols call for Brava devices to be worn for 2 to 4 weeks postoperatively to maximize fat graft take.⁴⁸ Donor sites are typically covered with compressive dressings to prevent seroma formation.⁵¹

Complications

Despite high overall rates of success associated with cosmetic fat grafting procedures to the breast, these operations are not without complications. The most common adverse events observed are the development of minor contour irregularities and palpable areas of induration.^{52,53} Other reported complications include persistent pain at the site of injection, hematoma formation, fat necrosis, oil cyst formation and

Table 1 Reported complication rates of autologous fat grafting in cosmetic breast reconstruction^a

Complication	Reported rate (%)	95% confidence interval
Palpable indurations	33.3	20.4–46.3
Persistent pain	25.0	0.5–49.5
Hematoma	16.4	14.5–18.4
New nodules	11.0	8.6–13.4
Abnormal breast fluid	8.3	0.0–42.9
Dysesthesia	7.7	3.8–11.6
Fat necrosis	6.6	5.5–7.7
Calcifications	4.5	2.8–6.6
Breast striae	4.3	3.0–5.6
Cyst formation	3.3	1.9–4.7
Breast infection	0.9	0.5–1.2
Donor site infection	0.6	0.0–3.9
Overall complication	17.2	15.9–18.5

^aThese complication rates were reported by Groen et al's 2016 systematic review.⁵

calcification, infection, and development of breast striae.^{54–57} At the donor site, regional deformation has also been reported to occur.⁵⁴ If a new, palpable lump is felt following fat grafting procedures to the breast, a mammogram is indicated for initial evaluation, and subsequent biopsies may be indicated if the imaging results are inconclusive.^{4,22}

In 2016, Groen et al conducted a systematic review investigating the outcomes and complications of autologous fat grafting in cosmetic breast augmentation.⁵ The study included 22 articles and more than 35,000 patients. A complication rate of 17.2% was seen. Indurations were the most frequent complication (33.3%) followed by persistent pain (25%) and hematoma (16.4%). Mammograms revealed microcalcifications (9.0%) and macrocalcifications (7.0%). Complication rates are summarized in ►Table 1.

Patient Satisfaction

Groen et al's systematic review also investigated patient and provider satisfaction. The study results demonstrated that 92% of patients and 89% of surgeons were satisfied with the final result.⁵ Fat grafting procedures to improve the aesthetic appearance of the breasts following breast cancer surgery and reconstruction have also been strongly linked to improved patient psychosocial well-being and enhanced sexual satisfaction.^{58–60} Autologous fat transfer thus has a high probability of producing satisfactory results for women desiring indicated aesthetic improvements in the appearance of their breasts. However, crucial to these high rates of satisfaction is the in-depth preoperative patient education to set realistic expectations for their postoperative results.

Oncological Safety

Although historical concerns regarding breast cancer screening capabilities in patients with a history of fat grafting to the breasts have largely been mitigated, advances in the fields of stem cell research and tissue engineering have increased awareness of the important role that adipose-derived ASCs play in the survival of fat grafts.^{6,10,12,22,59} Initially, there was suspicion that the ASCs' promotion of angiogenesis and tissue proliferation could potentially be unsafe to incorporate into the reconstructive plans for patients with a history of breast cancer.⁶¹ Indeed, experiments in immunodeficient mice suggested that when coinjected with active tumor cells, ASCs led to increased rates of cell division and cancer growth.^{62–64} Clinical evidence, however, has not supported these findings in humans. Several meta-analyses and systematic reviews have unanimously concluded that autologous fat transfer does not lead to an increased rate of locoregional breast cancer recurrence.^{65–70} However, as mentioned previously, a higher rate of biopsies exists with patients who have undergone fat grafting to the breasts compared with the general population, as fat necrosis may be difficult to distinguish radiographically from breast cancer.^{21,22} That is, to date there is a substantial amount of evidence that fat grafting remains a safe and highly effective option for cosmetic breast surgery in patients with a history of breast cancer.⁵⁹

Conclusion

The past two decades have witnessed growing application of autologous fat grafting in cosmetic breast surgery. Overall, fat grafting to the breast for cosmetic purposes has proven to be a safe, increasingly popular procedure with high levels of patient and provider satisfaction. Particularly for breast augmentation, fat grafting has shown great aesthetic outcomes with high patient satisfaction in regard to the size, shape, and texture of the breast mound.

Conflicts of Interest

None of the authors have a financial interest in any of the drugs, devices, procedures, or companies mentioned in this article. The authors have nothing to disclose.

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