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Breast

3D Lipogluing: Preliminary Results of a Novel Technique for Direct Three-dimensional Fat Grafting in Breast Reconstruction Surgery

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Summary: Lipofilling has emerged as an effective technique in breast reconstruction for enhancing aesthetic outcomes and addressing residual deformities. Traditionally, fat grafting has been performed as a secondary step in implant-based breast reconstruction during the replacement of the expander with a breast implant or as a revisional procedure. Our study investigates the technical feasibility and presents preliminary results of a new promising technique for delivering fat grafting in a three-dimensional (3D) shape, directly during mastectomy with immediate breast reconstruction or in delayed breast reconstructive procedures. Our new 3D lipogluing technique involves securing the fat tissue in a 3D manner using fibrin glue. This method enhances the coverage of soft tissues and provides improved volume and shape supplementation. In selected cases between December 2015 and September 2023, we treated 24 patients using the 3D lipogluing technique and five patients using 3D lipocubing (without use of fibrin glue). The patient cohort consisted of different indications for breast reconstructions: direct-to-implant, expander-based breast reconstruction, and "conservative" surgery. Preliminary findings suggest the technique is a safe and effective approach that can enhance the soft-tissue envelope of reconstructed breasts by acting as an autologous scaffold, owing to its regenerative properties. This technique not only improves the overall aesthetic outcome but also has the potential to reduce implant-related complications. Furthermore, ongoing studies are investigating methods to optimize the results and explore the potential application of 3D lipogluing and 3D lipocubing in breast-conserving oncoplastic surgery, cosmetic breast surgery, and other areas of plastic reconstructive and aesthetic surgery. *(Plast Reconstr Surg Glob Open 2024; 12:e5788; doi: 10.1097/GOX.0000000000005788; Published online 3 May 2024.)*

INTRODUCTION

Lipofilling has brought about a technical advancement in the field of plastic surgery,[1,2] finding extensive application[3,4] in patients with breast cancer.[5–7] Traditionally, lipofilling is used during the second stage of implant-based breast reconstruction or addressing residual deformities as a revisional procedure.[8] We investigated the feasibility and presented the preliminary results of three-dimensional (3D) lipogluing,[9] a novel and promising technique for delivering 3D fat grafting directly during mastectomy and immediate breast reconstruction procedures. Furthermore, we explored its potential application in breast reconstruction rescue scenarios, where it could be used to plan delayed expander/prothesis-based reconstruction or, in selected cases, to facilitate a more efficient approach during breast-conserving surgery.[10,11] The breast reconstruction procedure begins following mastectomy, considering the options of direct-to-implant (DTI)[12] or a two-stage reconstruction using a breast expander.

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For subpectoral expander-based breast reconstruction, a complete submuscular pocket is prepared by partially recruiting the extension of the fascia of the rectus muscles and part of the serratus muscle. To mitigate potential breast animation deformity arising from pectoral muscle contract, a surgical approach akin to dual-plane breast augmentation is undertaken. The inferior margin of the pectoral muscle is deliberately incised, disrupting its fibers and inducing partial denervation. This strategic intervention serves to prevent or minimize the aforementioned deformity, enhancing the overall aesthetic outcome of the reconstruction procedure.[13–17]

Fat is harvested using the Coleman technique,[3,18–20] employing a handheld syringe with manual suction and a 3-mm blunt cannula. The harvested fat is processed by filtration using a metal sieve and washed with normal saline. The adipose tissue graft is then "glued" in place using fibrin glue[21–24] (ARTISS Baxter, Deerfield, Ill.),[25–32] creating our 3D lipoglued graft to augment the subcutaneous thickness of the mastectomy flaps. [**See Video 1 (online)**, which shows a 3D lipogluing technique in two-step breast reconstruction after mastectomy. In this video, we present a clinical case of a 56-year-old patient who initially underwent a nipple-sparing mastectomy. Perioperative, thin mastectomy flaps and poor subcutaneous tissue were identified, which may limit the feasibility of breast reconstruction and the quality of the results. Therefore, the patient had a reconstruction using a retropectoral expander and a 3D lipoglued adipose tissue graft directly during the mastectomy procedure. This approach aimed to increase the subcutaneous thickness of the mastectomy flaps and enhance the soft-tissue envelope of the reconstructed breast. We provide intraoperative images and videos to elucidate the technique and further highlight the indications for our 3D lipogluing technique in breast reconstruction after mastectomy. The Coleman technique is utilized to harvest fat, employing a handheld syringe with manual suction and a 3-mm blunt cannula. Subsequently, the harvested fat undergoes filtration using a metal sieve and is washed with normal saline. The obtained adipose tissue graft is subsequently secured in position using fibrin glue and applied onto the pectoral muscle, forming our 3D lipoglued graft to enhance the subcutaneous thickness of the mastectomy flaps. Final outcomes are presented after 5 years. The primary objective of the 3D lipogluing technique is to augment the soft-tissue envelope of a reconstructed breast. This soft-tissue supplementation not only enhances overall aesthetic outcomes but also serves to mitigate the risk of implant-related complications such as wrinkling and visibility.]

For prepectoral expander-based breast reconstruction, a 3D lipoglued graft is prepared and applied on top of the expander, secured in the right position within the breast footprint using its suture tabs. Efforts are being made to develop better methods for stabilizing and securing the graft on top of the breast expander, doing this with the ultimate goal of aiming for a prepectoral composite breast reconstruction.[33,34]

We recommend conducting a thorough review of the patient's history for any prior exposure to sealants whenever the use of fibrin glue is anticipated. This precaution is aimed at minimizing the risk of allergic reactions, particularly aprotinin-related, and we advise avoiding a re-exposure interval of less than 12 months.[21]

In cases of DTI reconstruction combined with the 3D lipogluing technique, a submuscular pocket is created by partially recruiting the extension of the fascia of the rectus muscles and part of the serratus muscle. The inferior margin of the pectoral muscle is partially cut to prevent or reduce breast animation deformity caused by pectoral muscle contraction.

If the mastectomy flaps are deemed suitable for DTI reconstruction, a breast implant is inserted into the subpectoral-serratus muscular pocket, utilizing the muscle and fascial support at the level of the rectus muscles and inferior-lateral pole to create an "internal bra" to improve prosthesis stabilization. After implant placement, the partial muscle pocket is completed with a lateral suture.

The patient is then positioned upright to assess symmetry and the final result, determining where 3D lipoglued grafting could be beneficial in achieving increased coverage thickness, aesthetic improvements, and correcting or preventing residual deformities.[4,35–37] To "glue" and fix the fat tissue, ARTISS Baxter was sprayed over the entire surface of the muscular pocket and any small exposed areas of the prosthesis for receiving and adhering the 3D lipoglued graft that was set up externally. The skin flaps of the mastectomy are pulled over the new layer of lipoglued fat graft to adhere to the new soft-tissue layer. Typically, two drains are placed. During rescue breast reconstruction procedures after device removal, for planning a delayed implant-based reconstruction, a thick layer of 3D lipogluid fat graft is applied to facilitate the restart of an expander-based breast reconstruction. In the case of a woman who underwent breast-conserving surgery for three large adjacent benign lesions (fibroadenoma), the empty space was filled with the same volume of 3D lipoglued fat graft, aiming to replace not only "like to like" but also adhering to a reconstructive philosophy of "like for better," replacing the hard tissue of the fibroadenoma with a more physiological adipose tissue graft[38,39] as verified by magnetic resonance imaging result at 1 year. [**See Video 2 (online),** which shows a 3D lipogluing technique in mini-invasive breast reconstruction. In

Takeaways

Question: Is it possible to enhances the thickness and coverage of the breast envelope in a proactive approach augmenting the soft-tissue directly during mastectomy and breast reconstruction?

Findings: Our study investigates the technical feasibility and presents preliminary results of a new promising technique for delivering fat grafting in a three-dimensional shape directly during breast reconstruction and in other fields of plastic surgery.

Meaning: The 3D lipogluing and 3D lipocubing technique positions the adipose tissue to "fill a tissue void" in a space different from that foreseen for the standard lipofilling.

Fig. 1. Skin and subcutaneous flap thickness immediately after mastectomy and placement of a breast expander for prepectoral breast reconstruction in a two-stage procedure.

this video, we present a clinical case involving a 27-year-old patient who underwent breast conservative surgery for three large adjoining benign lesions in January 2023. During the procedure of excision, a 3D lipoglued adipose graft was directly applied. We provide intraoperative images and videos to explain the technique of our 3D lipogluing technique in breast reconstruction after breast conservative surgery. Fat is harvested utilizing the Coleman technique, using a handheld syringe with manual suction and a 3-mm blunt cannula. Subsequently, the harvested fat undergoes filtration using a metal sieve and is washed with normal saline.

In this scenario of a woman undergoing breast-conserving surgery for three large adjoining benign lesions, fibroadenoma, the void behind is filled with an equivalent volume of 3D lipoglued fat graft. This approach aims not only to replace "like with like" but also aligns with a reconstructive philosophy of "like for better," substituting the dense tissue of the fibroadenoma with a more physiologically compatible adipose tissue graft. We present the clinical outcomes and noncontrast magnetic resonance imaging results at 12 months after breast conservative surgery for the excision of three large adjacent benign lesions in the right breast, subsequently filled with a 3D lipoglued fat graft.]

A total of 24 patients were treated using the 3D lipogluing technique: three underwent DTI reconstruction, 15 received expanders (four in the prepectoral plane), two attempted full autologous breast reconstruction, three underwent breast reconstruction rescue procedures, and one underwent a procedure following partial conservative surgery for a benign lesion. Additionally, from March to September 2023, five patients were treated with the 3D lipocubing technique without the use of fibrin glue: two patients during the replacement of the expander with a breast implant to address the upper pole deficit following capsulectomy and three patients during retropectoral breast expander positioning. [**See Video 3 (online),** which shows a 3D lipocubing technique to fill the deficit of the upper pole after capsulectomy during the replacement of the expander with a breast implant. In this video, we present a clinical case involving a 53-year-old patient who underwent a right skin-reducing nipple-sparing mastectomy and reconstruction with a retropectoral expander by another colleague in December 2021. Subsequently, in August 2023, during the replacement of the expander with a breast implant, we utilized the 3D lipocubing adipose graft technique (without the use of fibrin glue), to address the deficit in the upper pole following its capsulectomy. We showcase intraoperative images and videos to elucidate the technique and indications of our 3D lipocubing technique in breast reconstruction, as well as its clinical outcomes.] The mean age of the patients was 47.6 years (range: 26–62 y), with an average follow-up period of 52 months (range: 3 mo to 7.7 y).

Fig. 2. The 3D lipoglued fat graft prepared externally before application onto the surface of the breast expander. Fat was harvested using the Coleman technique, employing a 20-mL handheld syringe under low negative pressure with manual suction and a 3-mm blunt cannula from the abdominal region, adjusted according to the patient's preference and anatomical possibility. The harvested fat was filtered using a metal sieve and washed with normal saline to minimize residual fluid, oil, and blood. This processed fat was subsequently "3D lipoglued" as described by Verga's technique, spraying fibrin glue (ARTISS Baxter), according to the instructions and specifications [see "Selected and Important Risk Information for ARTISS (Fibrin Sealant)" provided by the manufacturer].

DISCUSSION

The utilization of 3D lipogluing or 3D lipocubing in breast reconstruction represents an evolution in the reconstructive process, aiming to enhance the soft-tissue envelope of reconstructed breasts by adopting a proactive approach and augmenting the soft tissue during the initial stages of breast reconstruction, either by serving as a graft of an autologous scaffold or by utilizing its regenerative properties within the microenvironment and vascularization of the graft site (see Figs. 1–4). Comparable to traditional lipofilling[6] in breast reconstruction, this technique proves to be safe, as minimal postoperative complications were observed,[40–42] including the appearance of oily cysts only with thicknesses exceeding 1 cm. One of the notable advantages is its potential to mitigate implant-related complications, including implant visibility, rippling/wrinkling,

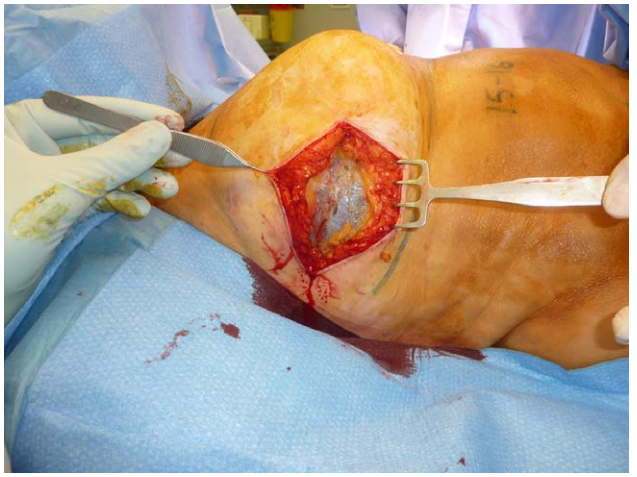

Fig. 3. Skin and subcutaneous mastectomy flap thickness at the second stage during expander-to-implant exchange, corresponding to the mastectomy incision point in Figure 1: the results of engraftment and revascularization process within the 3D lipoglued adipose graft at 18 months post-3D lipogluing procedure in prepectoral breast reconstruction performed in two stages. Additionally, histological biopsy executed in this area just on peri-expander capsule reported "fibroadipose tissue."

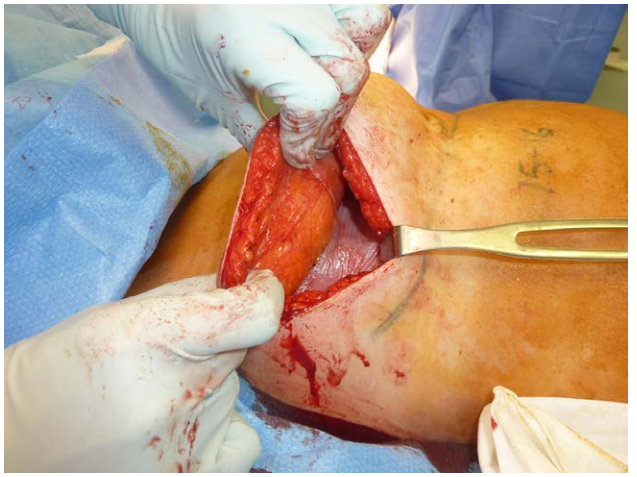

Fig. 4. Close-up of increased subcutaneous upper pole mastectomy flap thickness at the second stage during expander-to-implant exchange, corresponding to the mastectomy incision point in Figure 1.

subcutaneous hollowing, and thinning of the skin and subcutaneous tissues.[43] Additionally, in selected cases, it may serve as an option to replace excised volume in breast conservative surgery.

However, further extensive studies[44–46] with longer follow-up periods are necessary to thoroughly evaluate the long-term safety and aesthetic outcomes. Additionally, exploring its potential application after conservative oncoplastic breast surgery, in cosmetic breast surgery, and in other fields of aesthetic surgery would contribute to a comprehensive understanding of its indications and benefits. Presently, its function as an autologous scaffold is mainly attributed to its regenerative capabilities, notably within the range of 6–8 mm in thickness.

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DISCLOSURE

The authors have no financial interest to declare in relation to the content of this article.

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HELSINKI DECLARATION

This study was conducted according to the Declaration of Helsinki developed by the World Medical Association and subsequent amendments, and an informed consent was obtained in writing form each patient selected for the study.

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