Ultrasound-Assisted Liposuction as a Treatment of Fat Necrosis After Deep Inferior Epigastric Perforator Flap Breast Reconstruction

A Case Report

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Abstract: A single case is reported utilizing ultrasound-assisted liposuction (UAL) to treat fat necrosis after deep inferior epigastric artery perforator flap breast reconstruction. UAL treatment resulted in softening of the fibrous fat necrotic areas, while maintaining acceptable breast contour. UAL is safer and less invasive than traditional treatments for fat necrosis including direct excision and suction-assisted liposuction.

Key Words: breast reconstruction, DIEP flap, perforator flap, autologous breast reconstruction, ultrasound-assisted liposuction, fat necrosis

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Fat necrosis is a well-documented complication of autologous breast reconstruction.[1,2] It is characterized as an area of firmness within adipose tissue that results after fat becomes devitalized. Fat necrosis has been reported with nearly all techniques that use the abdominal wall donor site for reconstruction, including pedicled transverse rectus abdominis myocutaneous (TRAM), free TRAM, superficial inferior epigastric artery (SIEA), and deep inferior epigastric artery perforator (DIEP) flaps.[3,4] The esthetic impact of fat necrosis on the breast reconstruction varies depending on relative size and location of the tissue involved. In many cases, direct excision may result in an undesirable contour deformity. We report a case of fat necrosis after DIEP flap that was successfully treated by ultrasound-assisted liposuction (UAL).

CASE REPORT

Our patient is a 58-year-old female with diffuse ductal carcinoma in situ (DCIS) requiring mastectomy. The patient opted for DIEP flap breast reconstruction with intentional downsizing of the breast. She underwent skin-sparing mastectomy with immediate DIEP flap reconstruction based on a single, large, and contralateral medial row perforating vessel. The internal mammary vessels were used as the recipient vessels for revascularization and were exposed via a partial resection of the fourth costal cartilage. A 2.5-mm vein coupler (Synovis Life Technologies, St. Paul, MN) was used to perform the venous anastomosis. The arterial anastomosis was hand-sewn using interrupted 8-0 nylon suture. The final DIEP flap weight at inset was 560 g, which replaced the 1004-g mastectomy specimen. The patient tolerated the procedure well and, after an uneventful hospital course, was discharged to home on postoperative day three.

In follow up, the patient was noted to develop fat necrosis along the superior border and the inferior medial margin of the DIEP flap. The patient reported discomfort on palpation of these regions. Daily massage to the affected areas slightly decreased the size but did not result in complete resolution of firmness. The superior border area of fat necrosis measured approximately 3 cm × 7 cm and the inferior medial area measured approximately 4 cm × 5 cm. (Figs. 1 and 2). The fat necrosis can be readily visualized as a solid ridge along the superior medial border of the DIEP flap causing contour abnormality.

At 10 months postoperatively, the patient electively returned to the operating room for her second stage procedure including left DIEP flap revision with UAL, left nipple creation, right breast reduction for symmetry, and bilateral abdominal dermatolipectomy for revision of the abdominal incision.

After infiltration of 100 mL of tumescent solution to the areas of fat necrosis, UAL was performed using the LySonix 3000 machine (Byron Medical, Tucson, AZ) with a 4 mm × 20 cm hollow golf tip cannula on settings of power level 4 and 70% pulse duration (Fig. 3). Approximately 20 mL of aspirate was obtained. There was immediate on-table softening of the firm areas without creating a noticeable contour deformity. In follow-up, the previous areas of discomfort were no longer symptomatic with palpation, and the tissue consistency in these areas had become much softer. The patient chose to undergo a second treatment of UAL to

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FIGURE 1. Ten months status post left deep inferior epigastric perforator flap with superior and inferiomedial fat necrosis, frontal view.

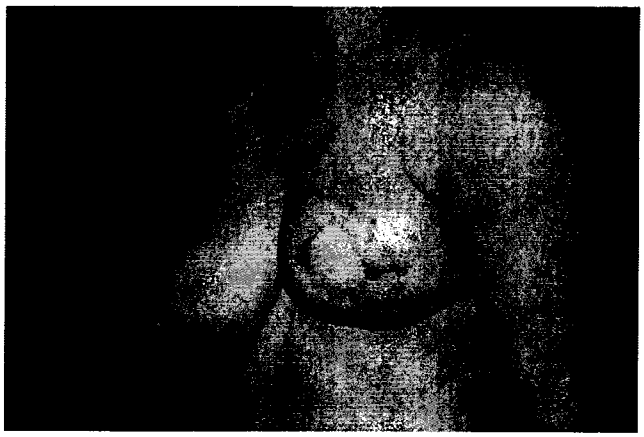

FIGURE 2. Ten months status post left deep inferior epigastric perforator flap with superior and inferiomedial fat necrosis, oblique view.

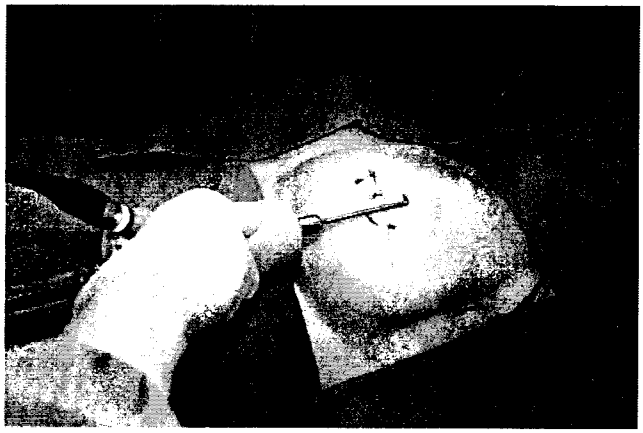

FIGURE 3. Ultrasound-assisted liposuction directed at superior area of fat necrosis.

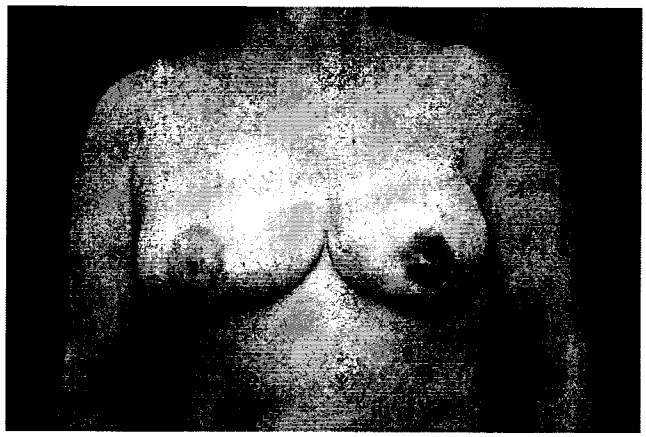

FIGURE 4. Three months status post 2 ultrasound-assisted liposuction treatments to superior and inferiomedial fat necrosis of left deep inferior epigastric perforator flap, frontal view.

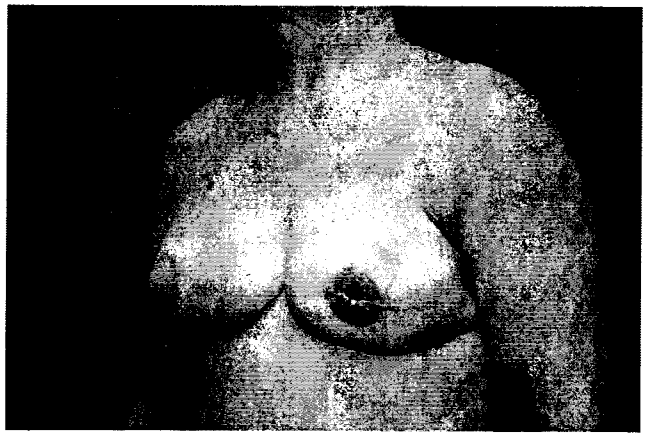

FIGURE 5. Three months status post 2 ultrasound-assisted liposuction treatments to superior and inferiomedial fat necrosis of left deep inferior epigastric perforator flap, oblique view.

address the minimal residual firmness in the superior border of the DIEP flap. At 4 months after the first treatment, the patient returned to the operating room. Similar technique was used, and approximately 10 mL of aspirate obtained. At 3 months follow up from the patient's second UAL treatment, there was no further rigidity in the superior portion of the DIEP flap and the patient was extremely satisfied with her results. (Figs. 4 and 5). The visible solid ridge seen in the superior medial border of the DIEP flap has resolved, and the flap has a significantly improved upper pole contour.

DISCUSSION

Fat necrosis after autologous breast reconstruction has unfortunately proven to be a frequent complication. In the literature there are wide ranges of incidence that varies among methods of pedicled TRAM (12%–35%), free TRAM (5.9%–12.9%), and DIEP (6%–62.5%) flap breast reconstructions.[3 7] Fat necrosis significantly increases with post-

operative flap radiation (34%) and will continue to plague reconstructive surgeons as the inclusive criteria for postmastectomy radiotherapy expands.[8,9] The scope of fat necrosis is difficult to assess because there is not a standard gradation system that allows practitioners to compare their results to the literature. Authors have defined fat necrosis as "any palpable firmness greater than 1 cm in diameter that was found in the breast 3 months or more after [sic] that was not caused by recurrent tumor"[3] or as a "hardening of a portion of the fat component with complete viability of the cutaneous component" that is further graded as mild, moderate, or severe depending on percentage flap involvement.[7]

Regardless of the specific definition, these firm areas of fat necrosis are often painful to the patient and can be esthetically compromising. To date, there is no published treatment protocol for fat necrosis. In our practice, initial management consists of daily massage to the affected regions. We have found that small areas of fat necrosis (<2 cm in diameter) may resolve over time with this therapy. Larger areas (>2 cm in diameter) may decrease in size but will not completely resolve. In the past, we have treated unresolved fat necrosis with direct excision or suction-assisted lipectomy. Both methods have proven effective in removal of the necrotic areas, but also have potentially negative side effects. Although both treatments have reduced the patient's discomfort associated with the fat necrosis, they also may result in a major contour deformity of the flap reconstruction. The degree of contour deformity is dependent on location and relative size of the fat necrosis. Small areas that are laterally or inferiorly oriented are easier to disguise, whereas larger areas that are superior or medial on the flap often leave an identifiable divot after resection/suction. In an attempt to improve cosmetic outcome with significant fat necrosis, an alternative treatment method of UAL was employed.

UAL was first described by Zocchi in 1988.[10] Since its invention, several design revisions have taken place to enhance use and minimize complications.[11] Currently, the Lysonix system uses ultrasound energy to cavitate tissues and a hollow cannula that allows for simultaneous aspiration and ultrasound delivery. Because of the cavitation properties, markedly fibrous tissues can be penetrated with ease.[12] For example, surgeons have successfully treated gynecomastia and HIV-associated dermatocervical fat pads with UAL.[13–15] Because fat necrosis is extremely firm and difficult to penetrate, we theorized that UAL may allow for enhanced therapy with a safer application. Fat necrosis of a breast reconstruction flap is immediately adjacent to vital organs, and may also be located near the fragile vascular pedicle. Traditional suction-assisted lipectomy cannulas can be problematic to manage due to the great force required to actively penetrate the firm mass of fat necrosis. In this case, the UAL cannulas passed with ease into the areas requiring treatment, in a very controlled and precise fashion. Liposuction was completed when the areas of firmness softened and a favorable contour remained. A single treatment with UAL resolved the discomfort on palpation associated with the area of fat necrosis. In addition, there was a great deal of softening of the fat necrosis regions. In this case, a second treatment with UAL was employed to obtain complete resolution of symptoms. Histologic analysis was not performed on the aspiration specimen due to the high percentage (70%–90%) of cellular disruption in UAL aspirate found in a previous study.[16]

We have found several advantages of UAL over direct excision. First, UAL is less invasive. Treatment can be performed through distant previously made scars, like those found around the skin island in a skin sparing breast reconstruction. For direct excision, the entire mastectomy skin flap may need to be re-elevated if the fat necrosis is located at the perimeter of the DIEP flap. In addition, UAL removes less tissue than direct excision, allowing tunnels for potential in-growth of healthy tissue with scar resorption.

Recurrent breast cancer is always a concern in this reconstruction patient population. There is a 10% to 12% rate of locoregional breast cancer recurrence at 10 years and the median interval to develop a postmastectomy locoregional recurrence is 2 to 3 years.[17,18] In our institution, post-DIEP flap patients are followed very closely. As the initial flap edema resolves, areas of fat necrosis become better defined. At 3 months from the initial procedure, the flap revision operations are planned. On examination, fat necrosis can be identified within the DIEP flap tissue as it does not involve the skin and is not fixed to the chest wall. In addition, these areas do not increase in size over time, as would be expected in local tumor recurrence. Because of these classic physical examination findings, close temporal relationship to mastectomy, and extremely close follow-up, we believe there is minimal chance of mistaking tumor recurrence with fat necrosis. If there is any concern about the characteristics of a firm area within or near the reconstruction, a biopsy to rule out local tumor recurrence is highly recommended. Close communication with the breast surgeon is essential in management of any new lesion.

CONCLUSIONS

Fat necrosis is a well-recognized sequela after autologous reconstruction that can result in an unfavorable result. Care should be taken to thoroughly evaluate these firm areas, and if any concern exists regarding the diagnosis, a formal biopsy should be performed preoperatively to rule out local cancer recurrence. UAL was used in this case to successfully treat large areas of fat necrosis while maintaining a favorable contour. Although long term follow up and extended patient populations must be investigated, ultrasound-assisted liposuction has shown to be a successful therapy for autologous breast reconstruction fat necrosis. Currently a series of cases utilizing UAL to treat fat necrosis is being collected at our institution. Similar outcomes with favorable resolution of fat necrosis and satisfactory contour are already being observed.

REFERENCES

1. Williams JK, Bostwick J III, Bried JT, et al. TRAM flap breast reconstruction after radiation treatment. *Ann Surg.* 1995;221:756–764.
2. Jewell RP, Whitney TM. TRAM fat necrosis in a young surgeon's practice: is it experience, technique, or blood flow? *Ann Plast Surg.* 1999;42:424–427.
3. Kroll SS. Fat necrosis in free transverse rectus abdominis myocutaneous and deep inferior epigastric perforator flaps. *Plast Reconstr Surg.* 2000; 106:576–583.

4. Kroll SS, Gherardini G, Martin JE, et al. Fat necrosis in free and pedicled TRAM flaps. *Plast Reconstr Surg.* 1998;102:1502–1507.
5. Chang DW, Wang B, Robb GL, et al. Effect of obesity on flap and donor-site complications in free transverse rectus abdominis myocutaneous flap breast reconstruction. *Plast Reconstr Surg.* 2000;105:1640–1648.
6. Gill PS, Hunt JP, Guerra AB, et al. A 10-year retrospective review of 758 DIEP flaps for breast reconstruction. *Plast Reconstr Surg.* 2004;113:1152–1160.
7. Nahabedian MY, Momen B, Galdino G, et al. Breast Reconstruction with the Free TRAM or DIEP Flap: patient selection, choice of flap, and outcome. *Plast Reconstr Surg.* 2002;110:466–475.
8. Tran NV, Evans GR, Kroll SS, et al. Postoperative adjuvant irradiation: effects on tranverse rectus abdominis muscle flap breast reconstruction. *Plast Reconstr Surg.* 2000;106:313–317.
9. Pomahac B, Recht A, May JW, et al. New trends in breast cancer management: is the era of immediate breast reconstruction changing? *Ann Surg.* 2006;244:282–288.
10. Zocchi M. New perspective in lipoplasty: the ultrasonic-assisted lipectomey (UAL). Presented at the Annual Congress of the French Society of Asthetic Surgery, Paris, May 1988.
11. Beckenstein MS, Grotting JC. Ultrasound-assisted lipectomy using the solid probe: a retrospective review of 100 consecutive cases. *Plast Reconstr Surg.* 2000;105:2161–2174.
12. Goes JC, Landecker A. Ultrasound-assisted lipoplasty (UAL) in breast surgery. *Aesthetic Plast Surg.* 2002;26:1–9.
13. Rohrich RJ, Ha RY, Kenkel JM, et al. Classification and management of gynecomastia: defining the role of ultrasound-assisted liposuction. *Plast Reconstr Surg.* 2003;111:909–923.
14. Piliero PJ, Hubbard M, King J, et al. Use of ultrasonography-assisted liposuction for the treatment of human immunodeficiency virus-associated enlargement of the dorsocervical fat pad. *Clin Infect Dis.* 2003;37:1374–1377.
15. Hong JP, Shin HW, Yoo SC, et al. Ultrasound-assisted lipoplasty treatment for axillary bromidrosis: clinical experience of 375 cases. *Plast Reconstr Surg.* 2004;113:1264–1269.
16. Rohrich RJ, Morales DE, Krueger JE, et al. Comparative lipoplasty analysis of in vivo-treated adipose tissue. *Plast Reconstr Surg.* 2000;105:2152–2158.
17. Buchanan CL, Dorn PL, Fey J, et al. Locoregional recurrence after mastectomy: incidence and outcomes. *J Am Coll Surg.* 2006;203:469.
18. Van Dongen, JA, Voogd, AC, Fentiman, IS, et al. Long-term results of a randomized trial comparing breast-conserving therapy with mastectomy: European Organization for Research and Treatment of Cancer 10801 Trial. *J Natl Cancer Inst.* 2000;92:1143.