Complications and Surgical Treatment of Breast Augmentation Using Autologous Fat Transfer and Fillers

Shigeki Sakai, MD, PhD* Naohiro Ishii, MD, PhD† Yukie Nakamura, MD‡ Kyoichi Matsuzaki, MD, PhD† Shigemi Sakai, MD, PhD§ Kazuo Kishi, MD, PhD*

From the *Department of Plastic and Reconstructive Surgery, Keio University School of Medicine, Shinjuku, Tokyo, Japan; †Department of Plastic and Reconstructive Surgery, School of Medicine, International University of Health and Welfare, Narita, Chiba, Japan; ‡Department of Plastic and Reconstructive Surgery, Ofuna Chuo Hospital, Kamakura, Kanagawa, Japan; and §Shinjyuku Cosmetic Surgery and Dental, Shinjuku, Tokyo, Japan.

Received for publication January 19, 2021; accepted June 4, 2021.

Copyright © 2021 The Authors. Published by Wolters Kluwer Health, Inc. on behalf of The American Society of Plastic Surgeons. This is an open-access article distributed under the terms of the Creative Commons Attribution-Non Commercial-No Derivatives License 4.0 (CCBY-NC-ND), where it is permissible to download and share the work provided it is properly cited. The work cannot be changed in any way or used commercially without permission from the journal.

DOI: 10.1097/GOX.0000000000003734

Background: Breast augmentation with autologous fat grafting or hyaluronic acid injection requires minimal loss of healthy tissue. With an increasing trend of breast augmentation with these fillers, accompanying complications have also increased. Patients with complications often complain of induration, cyst formation, calcification, and infection, which require surgical treatment. We will discuss these complications and their surgical treatment throughout our experience of cases.

Methods: This retrospective study included 20 patients who all required surgical treatment due to breast augmentation complications such as induration, cyst formation, calcification, and infection, and who visited us between May 2007 and June 2018. The patients’ ages ranged from 25 to 63, and the mean age was 39.9. The material used for breast augmentation was fat for 17 cases, and hyaluronic acid, paraffin, and silicon for one case each. The results were analyzed through plastic surgeons at our hospital.

Results: We performed a zigzag incision in the peri-areolar margin to 17 of 18 patients for complications of autologous fat grafting and hyaluronic acid injection. The one excluded patient required an adipofascial flap from an inframammary fold incision. For one patient with silicon injection complication and one patient with paraffin injection complication, each required mammary gland resection.

Conclusions: A zigzag incision in the peri-areolar margin was useful for treating complications of breast augmentation with autologous fat grafting and hyaluronic acid injection. All cases resulted in inconspicuous fine scars, with high patient satisfaction. However, this incision was insufficient to remove injected silicon and paraffin.

(Plast Reconstr Surg Glob Open 2021;9:e3734; doi: 10.1097/GOX.0000000000003734; Published online 16 August 2021.)

INTRODUCTION
Breast augmentation with fillers such as autologous fat grafting or hyaluronic acid injection requires minimal loss of healthy tissue, which makes it appealing to patients who opt for less invasive procedures. Filler injection for breast augmentation, as well as complications accompanying this procedure, show an increasing trend.1+ Many patients with breast augmentation complications, such as induration, cyst formation, calcification, and infection, attend our hospital for consultation and treatment, including surgery.

New techniques of fat injection have been reported, and results have improved over the years.1+ However, unsightly complications such as lumps and dimples are still common, and for example, a bolus injection of too much adipose tissue is said to raise the odds of complications. In hyaluronic acid injection, lumps due to pseudocystic encapsulation are a frequent complication. In this case, injecting hyaluronidase into each lump is often difficult, and even if they could be injected by hyaluronidase, the encapsulations often remain.

Currently, silicon and paraffin injections are prohibited in Japan. However, some patients who have undergone...
surgery overseas have these injections and are unaware of what was injected, especially those who have had multiple filler breast augmentations. To correctly cure their complications, it is better for us plastic surgeons to know the exact material that was injected, especially if it was something other than fat or hyaluronic acid. When a large mass is found through imaging, sometimes extended resection such as total breast removal become an option, as adhesion to normal tissue could be too strong.

METHODS

Informed consent and consent for publication were obtained from every individual whose data were included in the study. This retrospective study included 20 patients who all required surgical treatment due to breast augmentation complications such as induration, cyst formation, calcification, and infection that visited us between May 2007 and June 2018. The patients ranged in age from 25 to 63 years, and the mean age was 39.9 years (Table 1). There were 17 cases of injection with autologous fat grafting, and one case each of hyaluronic acid, paraffin, and silicon injection. None of the patients had undergone breast augmentation at our hospital and were referred without consultation or contact from other hospitals. Therefore, the details of injected materials and their volumes were unknown. The postoperative follow-up period was 1 week to 42 months. Zigzag incision in the peri-areolar margin was performed for 16 cases of fat injection and one case of hyaluronic acid injection. Fifteen patients, who we were able to observe for more than 1 postoperative month, were randomly evaluated by five plastic surgeons for breast morphology and areola scars.

We planned our zigzag incision on the side of the areolar border that is the closest to the mass within the breast. We made sure the Montgomery glands were included with the nipple areolar complex. We used Pictoranin temporal tattoos beforehand to be able to suture the correct edges together afterward. We used a buried suture technique for the corners of the zigzags with absorbable monofilaments.

Case 1 (Patient 2)

A 38-year-old woman underwent autologous fat grafting from both buttocks and thigh to both breasts at a certain cosmetic surgery clinic, 2.5 years before visiting our hospital. Immediately after the breast augmentation, she noticed unnatural lumps in both breasts. Although her doctor assured her that these lumps would naturally disappear, they did not disappear for 2 years, and she decided to consult us for treatment.

Table 1. Patient Profile Characteristics and their Disposition

| No. | Age (y) | Injection (years ago) | Preoperation | Incision | Follow-up (mo) | Remarks |
|-----|---------|-----------------------|--------------|----------|----------------|---------|
| 1   | 49      | Fat (1 years)         | Multiple lumps, Reddish skin on the lumps | Zigzag* | 18              | Calcification. Left side: scar redness 3 months postoperatively |
| 2   | 38      | Fat (2.5 years)       | Multiple lumps, Reddish skin on the lumps | Zigzag  | 42              | Case 1. Calcifications |
| 3   | 28      | Fat (4 years)         | Multiple lumping 10 days after injecting fat | Zigzag  | 1               | Right side calcifications |
| 4   | 50      | Silicon              | Induration   | IMF†     | 12              | Total mastectomy. DIEP flap both sides |
| 5   | 34      | Fat (10 years)        | Multiple lumps, Hyaluronic acid injection several times | Zigzag  | 0               | Multiple hyaluronic acid cysts. Multiple calcifications |
| 6   | 30      | Fat (3 years)         | One large lump on both sides           | Zigzag  | 7               | No calcification tumor. |
| 7   | 27      | Fat (8 years)         | Multiple lumps                           | Zigzag  | 18              | Calcifications on both sides. Right side: slightly wide white scar |
| 8   | 63      | SBI‡ (20 years)       | SBI removal and fat injection 6 years ago | IMF§     | 18              | Right side: loss of volume. Reconstruction by adipo-fascial flap from IMF incision |
| 9   | 46      | SBI (3 times)         | Multiple lumps                           | Zigzag  | 4               | Keep SBI |
| 10  | 64      | Fat (3 years)         | Induration                               | Spindle with nipple | 18              | Case 3. Auto-graft areola and nipple |
| 11  | 31      | Fat (0.5 years)       | Multiple lumps                           | Zigzag  | 18              | Oil cyst. Right side: hypertrophic scar 2 mm wide |
| 12  | 35      | Fat (13 years)        | One large lump on both sides. Left side: reddish skin on the lumps | Zigzag  | 12              | Case 4. Oil cyst and calcification. Left side: slight postoperative deformity |
| 13  | 27      | Fat (7 years)         | Multiple lumps                           | Zigzag  | 3               | Case 2. Calcification on both sides. |
| 14  | 25      | Hyaluronic acid (4 years) | Multiple lumps. Right side: huge lump. Small multiple lumps on both sides | Zigzag  | 3               | Case 3. Encapsulation |
| 15  | 27      | Fat (5 years)         | Right side lump                          | Zigzag  | 18              | Right side only |
| 16  | 42      | Fat (1 year)          | One large lump on both sides             | Zigzag  | 0               | Oil cyst both sides |
| 17  | 42      | Fat (3 years)         | One huge lump on both sides              | Zigzag  | 8               | Oil cyst both sides |
| 18  | 51      | Fat (6 years)         | Right side: 1 huge lump                  | Zigzag  | 6               | Calcification on both sides |
| 19  | 45      | Fat (1 year)          | One huge lump on both sides              | Zigzag  | 3               | The skin was thin, and lumps were visible, although they improved. |
| 20  | 45      | Fat (12 years)        | One huge lump on both sides              | Zigzag  | 1               | Calcification on both sides |

*Zigzag incision on the peri-areolar margin.
†IMF (inferior mammary fold) incision.
‡SBI (silicon bag implant).
to seek treatment from the same doctor of the same clinic. Her doctor diagnosed her with fat necrosis, and aspiration was immediately performed. However, this did not improve her condition; the precordial area began to swell, and indurations cephalic to the nipple areolar complex were detected on the right breast, while indurations caudal to the nipple areolar complex were detected on the left breast (Fig. 1A). Mammography revealed mass and calcification in both breasts. (See figures, Supplemental Digital Content 1, which displays (a) mammography: calcification and mass in both breasts; (b) mammography: calcification and mass in both breasts; (c) mammography: multiple lumps in both breasts; (d) pathology: an involucre is formed surrounding the hyaluronic acid particles; (e) pathology: voids due to necrotic tissue and liquefaction of fat are observed; (f) peri-surgical findings: tumors were adhered to the skin, so composite resection of the skin and mammary gland was performed. http://links.lww.com/PRSGO/B737.)

To remove this mass, a zigzag incision was designed on the cephalic peri-areolar margin of the right breast (Fig. 1B) and on the caudal peri-areolar margin of the left breast (Fig. 1C). The patient was satisfied with the even postsurgical shape of the breasts, minimal areolar deformation, and inconspicuous fine scars from the zigzag incision (Fig. 1D).

Case 2 (Patient 13)

Similar to case 1, a 27-year-old woman underwent autologous fat grafting at a certain cosmetic surgery clinic 2.5 years before visiting our hospital. She also noticed postsurgical lumps in both breasts. She waited for 7 years but they did not disappear, so she revisited and consulted a different doctor at the same clinic. Her doctor diagnosed her with seroma, and aspiration was performed. This did not improve the lumps, and only caused inflammation of the precordial area. Her doctor referred her to a dermatologist who prescribed topical corticosteroids, which slightly improved the precordial inflammation. However, the lumps persisted in both breasts, so the dermatologist referred her to our hospital. Upon palpation, indurations cephalic to both nipple areolar complexes were detected.

Fig. 1. Case 1 presentation and results. A, Presurgical findings: indurations located in the cephalic side of the right areola and the caudal side of the left areola. B, Peri-surgical findings (right breast): the zigzag incision line was designed in the cephalic side of the peri-areolar margin. C, Peri-surgical findings (left breast): the zigzag incision line was designed in the caudal side of the peri-areolar margin. D, 3 years after surgery: the shape of the breasts is basically equivalent before and after surgery, with minimal nipple–areolar deformations and inconspicuous scars.
Mammography revealed mass and calcification in the same area (see SDC1b, http://links.lww.com/PRSGO/B737). For tumor excision, a zigzag incision was made in the cephalic peri-areolar margin in both breasts (Fig. 2B). The patient was satisfied with the postsurgical breast shapes, minimal areolar deformation, and inconspicuous fine scars resulting from the zigzag incision (Fig. 2C).

Case 3 (Patient 14)
A 25-year-old woman underwent bilateral breast augmentation using hyaluronic acid at another hospital and was aware of many lumps in both breasts soon after. Sharp pain developed in both breasts 3 years later, and cyst formation due to hyaluronic acid was diagnosed from the same doctor at the same hospital. Although hyaluronidase injection was administered from a different doctor at the same hospital, the numerous lumps and stiffness failed to disappear. The doctor assured her that the stiffness would improve in time, but it did not, so she consulted our hospital (Fig. 3A). Large, palpable lumps were detected in the caudal area of her breasts, and especially large ones were found caudally to the nipple areolar complex. Thus, a zigzag incision was designed in the caudal peri-areolar margin to excise the lumps (Fig. 3B). The postsurgical breast shapes were satisfactory, areolar deformation minimal, and fine scars from the incision were barely visible (Fig. 3C).

RESULTS
We used a zigzag incision in the peri-areolar margin to treat 17 cases with complications following breast filler injections, including one hyaluronic acid injection case and 16 autologous fat grafting cases. For one case with dimpling in the breast after silicon bag implant removal, breast reconstruction was performed through infra mammary fold (IMF) incision, using an adipofascial flap. For one case of silicon injection and one case of paraffin injection, both required mammary gland excision (Table 1). If any case presented with calcification, enucleation was performed. In one of our autologous fat graft cases, the injected fat became liquefied to an oily cyst and slurry substance due to necrosis, which required excision and lavage (Fig. 4). (see SDC1e, http://links.lww.com/PRSGO/B737.)

For the hyaluronic acid injection case, multiple lumps from encapsulation of hyaluronic acid were detected upon palpation. Injecting hyaluronidase does not dissolve the hyaluronic acid that has already spread and formed several lumps. Injected hyaluronic acid cross-links and forms capsules over time, and does not absorb after forming these capsules, so surgical excision is necessary. On mammography, these capsules present as numerous masses without calcification (See SDC1c, http://links.lww.com/PRSGO/B737). The contents of these capsules were fine white granules, which pathologically revealed a round capsule surrounding the hyaluronic acid (See SDC1d, http://links.lww.com/PRSGO/B737). Although we excised these multiple capsules, complete removal was difficult, especially the extremely small ones.

For follow-up, among the 17 patients who underwent zigzag incision in the peri-areolar margin, two did not return after suture removal, and two did not return after the 1-month follow-up. Four patients stayed for only 3–5 months, and the remaining nine patients for more than 6 months (Table 1). The 15 patients who were observed for at least 1 month were evaluated for breast morphology by five plastic surgeons with over 6 years of experience.

DISCUSSION
Patients who undergo breast augmentation, especially by autologous fat grafting, have high cosmetic demands. We have had many patients who want to correct irregularities and indurations to the finest detail. Because such patients chose noninvasive breast augmentation in the first place, if they are proposed with an incision in the IMF for correction, they usually hesitate. When treating the 20 patients in this article, we prioritized treating the large lumps and abandoned the very small ones when surgical excision was too difficult, for we believed that digging in

![Fig. 2. Case 2 presentation and results. A, Presurgical findings: indurations located on the cephalic side of both areolae. B, Peri-surgical findings (left breast): the zigzag incision line was designed in the cephalic side of the peri-areolar margin. C, 3 months after surgery: the shape of the breasts is basically equivalent before and after surgery, with minimal nipple–areolar deformations and inconspicuous scars.](http://links.lww.com/PRSGO/B737)
deeper tissue and excising excessive tissue would result in additional breast deformation and scars.

Also, as you can see from our case series (Table 1), we have a high drop-out rate of patients who undergo surgery to correct indurations, which is much higher than our other plastic surgery out-patients. This may be one reason why there are only a few articles on the zigzag incision like ours. There are abundant reports on methods and complications for autologous fat grafts.1–4 Recent fat graft methods for breast augmentation tend to have less complications, such as Coleman’s method,5–6 composite breast augmentation,7 and correction of stenotic breast malformations using fat grafts.8 However, only a few summaries or compilations on how to treat them currently exist. We were also unable to find much detailed information on the zigzag incision, which we used. This zigzag incision in the peri-areolar margin has the effect of extending the wound length, enabling easier access to inside the breast compared with the conventional arcuate incision in the peri-areolar margin. Also, for the cephalically located tumors, we also think a zigzag incision on the cephalic side of the peri-areolar margin is better than a traditional skin incision in the IMF because it provides closer access and thus less exfoliation.

For patients who experienced noninvasive breast augmentation with fillers, their breast skin is normally soft with no scars. Therefore, the tumor can be approached from a small skin incision, which can be further facilitated by applying reverse traction with the retractor.

We designed a zigzag incision on the cephalic peri-areolar margin when the tumor is located in the cephalic side of the breast, and on the caudal margin when the tumor is located in the caudal side of the breast. Small tumors scattered throughout the breast can be easily removed by a zigzag incision in any side of the peri-areolar margin, depending on the distribution (Fig. 5).

This zigzag incision in the peri-areola margin is a cosmetically useful method because the wound most likely results in fine scars and is highly unnoticeable. Retrospectively, our 15 cases that were followed up for more than 1 month were evaluated by five plastic surgeons, and all were considered good or excellent. Also, patient satisfaction was also high, except for two cases without follow-up and three cases without zigzag margin around the areola.

It is important to explain to patients in advance that we may perform other methods of incision when the zigzag incision is insufficient to remove the mass. Other methods of incision include incision in the IMF, a direct incision above the tumor, resection of the skin when tumor is too tightly adhered to separate, and a combination of these.

We experienced breast augmentation by paraffin injection. Injection of silicon or paraffin is rarely seen today because it is prohibited in many countries, and our patient was unaware of what was injected. In our case, adhesion of paraffin to the skin was so severe that resection of the skin and mammary gland was inevitable (See SDC1f, Pt. No. 10, http://links.lww.com/PRSGO/B737).

Injection of foreign materials would sometimes result in infection. There are several reports on infection cases from breast augmentation that systemically spread and...
resulted in a septic shock. Such cases should be treated according to the guidelines on infections of their countries. Some reports claim that fat injection does not increase the risk of developing breast cancer, but long-term inflammation may increase the risk, and pathological analysis has been explored. Therefore, when resecting augmentation complications, it is preferable to consider having pathological tests performed.

We recommend an algorithm from our experience of treating these cases of breast augmentation complications. First, you must diagnose whether the patient has developed an acute infection or a chronic foreign body response. For acute infection, you should first administer antibiotics. Next, you should investigate the material of the filler used through history taking and imaging tests. If the material used is hyaluronic acid, try aspiration and injecting hyaluronidase. If this does not relieve the lumps, try surgical removal through the zigzag incision in the areolar margin. The zigzag incision should be enough to remove all units of hyaluronic acid. For autologous fat grafts, if the fat is an oil cyst, try aspiration, but if the graft is more solid with calcification, try the zigzag incision in the areolar margin. For silicon or paraffin injection, there is a higher chance of adherence to the skin or mammary glands. If there is a strong adherence to the skin, then skin resection is necessary, and the mass is approached from this resection. If there is no skin adherence, the mass is approached from the zigzag incision. However, if this incision provides insufficient access to the mass, then you should extend the zigzag incision laterally, or even add an IMF incision when necessary.

The overall timing of resection for chronic foreign body response should be at least half a year since the last surgery. In cases of acute infection, surgery should be planned quickly.

A major concern in patients who have received injection augmentation mammoplasty is delayed or compromised diagnosis of cancer. Injected foreign materials cause fibrosis and granulomatous reactions, which create tumors and architectural distortion that mimic neoplasm. Therefore, physical, mammographic, and sonographic examination for breast cancer is compromised, causing a delay in the diagnosis. In addition, foreign body reactions or recurrent infections, such as in our case, may lead to the formation of dystrophic calcification, which further complicates the detection of breast cancer. Also, there have been reports where injection augmentation such as polyacrylamide hydrogel may increase the risk of breast cancer. Therefore, we recommend submitting all masses removed from the breast to pathology.

Finally, all 15 of our zigzag incision cases that were followed up for more than 1 month were Japanese, who generally are more likely to produce more conspicuous scars compared with Whites. To further research the extent of this zigzag excision, evaluation for other races is necessary but can be estimated to have similarly good results.

CONCLUSIONS

Cases of breast augmentation by injecting autologous fat grafts and hyaluronic acid are increasing and so are reported complications from them. A zigzag incision in the peri-areolar margin is useful for treating these complications because it provides good view of the mass and leaves less-conspicuous scars.
ACKNOWLEDGMENTS

All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki Declaration and its later amendments or comparable ethical standards. This study was approved by the institutional review board (IRB)—institution: Keio University, National Committee: Independent Ethics Committee, IRB #20200162. I would like to thank Tatsuya Kato, MD; Yukari Nakajima, MD; Ikki Yuzaki, MD; Yoshiaki Sakamoto, MD, PhD; and Keisuke Okabe, MD, PhD for evaluating the cosmetic aspects of this article. Further, I also thank Miss Kazuko Inami for helping me with the text composition.

REFERENCES

1. Mineda K, Kuno S, Kato H, et al. Chronic inflammation and progressive calcification as a result of fat necrosis: The worst outcome in fat grafting. Plast Reconstr Surg. 2014;133:1064–1072.
2. Hyakusoku H, Ogawa R, Ono S, et al. Complications after autologous fat injection to the breast. Plast Reconstr Surg. 2009;123:360–370.
3. Rosing JH, Wong G, Wong MS, et al. Autologous fat grafting for primary breast augmentation: A systematic review. Aesthetic Plast Surg. 2011;35:882–890.
4. Hivernaud V, Lefourn B, Guicheux J, et al. Autologous fat grafting in the breast: critical points and technique improvements. Aesthetic Plast Surg. 2015;39:547–561.
5. Coleman SR, Saboiro AJ. Fat grafting to the breast revisited: safety and efficacy. Plast Reconstr Surg. 2007;119:775–85; discussion 786.
6. Kling RE, Mehrara BJ, Pusic AL, et al. Trends in autologous fat grafting to the breast: A national survey of the American Society of Plastic Surgeons. Plast Reconstr Surg. 2013;132:35–46.
7. Maione L, Caviggioli F, Vinci V, et al. Fat graft in composite breast augmentation with round implants: A new concept for breast reshaping. Aesthetic Plast Surg. 2018;42:1465–1471.
8. Klinger M, Klinger F, Giannasi S, et al. Stenotic breast malformation and its reconstructive surgical correction: A new concept from minor deformity to tuberous breast. Aesthetic Plast Surg. 2017;41:1068–1077.
9. Valdatta L, Thione A, Buoro M, et al. A case of life-threatening sepsis after breast augmentation by fat injection. Aesthetic Plast Surg. 2001;25:347–349.
10. Hardwicke JT, Bechar J, Skillman JM. Are systemic antibiotics indicated in aesthetic breast surgery? A systematic review of the literature. Plast Reconstr Surg. 2013;131:1395–1403.
11. Gutteridge M, Holden S, Clarkson A. 2009 Nottingham University Hospitals Antibiotic Guidelines for Adults. Available at: https://www.nuh.nhs.uk/handlers/downloads.ashx?id=36538. Accessed July 30, 2020.
12. Villani F, Caviggioli F, Giannasi S, et al. Current applications and safety of autologous fat grafts: A report of the ASPS Fat Graft Task Force. Plast Reconstr Surg. 2010;125:758–759.
13. Silva-Vergara C, Fontdevila J, Weshahy O, et al. Breast cancer recurrence is not increased with lipofilling reconstruction: A case-controlled study. Ann Plast Surg. 2017;79:245–248.
14. Youk JH, Son EJ, Kim EK, et al. Diagnosis of breast cancer at dynamic MRI in patients with breast augmentation by paraffin or silicone injection. Clin Radiol. 2009;64:1175–1180.
15. Lin WC, Hsu GC, Hsu YC, et al. A late complication of augmentation mammoplasty by polyacrylamide hydrogel injection: Ultrasound and magnetic resonance imaging findings of huge galactoceles in a puerperal woman with pathological correlation. Breast J. 2008;14:584–587.
16. Xi TF, Fan CX, Feng XM, et al. Cytotoxicity and altered c-myc gene expression by medical polyacrylamide hydrogel. J Biomed Mater Res A. 2006;78:283–290.